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IMPACT OF BIG DATA ON CONTROLLER'S ROLE IN STRATEGIC DECISION MAKING – CASE SOK

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Abstract

The purpose of this thesis is to investigate the impact of big data on controller's role in organizations and whether the phenomenon is furthering the trend of controllers playing a larger role in strategic decision making. Various organizational functions face new challenges as companies look to find financial value from access to new data sources and analytics tools. Management accountants should be aware of the opportunities and risks that big data offers. Is management accounting becoming marginalized by data specialists and operational managers or will controllers increase their influence by leveraging big data in financial analysis and strategic decisions?

This thesis is based on a qualitative case study that aims to provide a rich description of the social structures, decision making processes and interactions between diverse individuals in a unique organizational setting. Instead of testing a single existing theory, the thesis studies a phenomenon through a framework created by prior literature. It aims to act as a reality check to test the hypotheses of prior literature, not necessarily to confirm them. The empirical material of the study consists of nine semi-structured case interviews conducted in SOK, a corporation that offers various support functions and strategic guidance to the S Group, a network of largely Finnish companies operating in the retail and service sectors.

The research results indicate that big data is one of the many factors forcing controllers towards a more strategic role in organizations. New sources of data require more advanced analytics and automation, hence some of today's assisting accounting tasks are expected to be eliminated. However, controllers have not leveraged big data to increase their influence in strategic decisions. Lack of business understanding was identified as the most significant factor that prevents controllers from participating in strategic decision making and utilizing advanced data analytics in these decisions.

Controllers have not been in the forefront of leveraging big data in decision making. Instead of controllers acquiring a larger role in data analytics, the research results indicate that it is more likely that data experts would acquire the tasks of controllers. As data analysts are already collecting and analyzing financial information, it appears that traditional accounting tasks can be effortlessly transferred from controllers to data analysts. Currently, however, controllers' knowledge of accounting principles differentiates them from other professionals. To remain relevant and continue the expansion towards a more strategic role, controllers must find ways to leverage both new and existing sources of data in significant long-term business decisions. This will require a holistic understanding of the business and close cooperation with other professionals.

Keywords big data, strategic decision making, controller, management accountant

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Tiivistelmä

Tutkielman tavoite on selvittää, onko big data vaikuttanut controllerin rooliin organisaatioissa ja edistääkö se controllerin roolin laajenemista kohti strategista päätöksentekoa. Organisaatioiden eri toiminnot kohtaavat uusia haasteita, kun yritykset pyrkivät löytämään uusista datan lähteistä ja analytiikkatyökaluista taloudellista arvoa. Johdon laskentatoimen ammattilaisten tulisi olla tietoisia big datan tuomista uhkista ja mahdollisuuksista. Vähentääkö data-analytiikka johdon laskennan merkitystä organisaatioissa vai kasvattavatko controllerit vaikutusvaltaansa hyödyntämällä big dataa taloudellisessa analyysissä ja strategisessa päätöksenteossa?

Tämä tutkielma perustuu kvalitatiiviseen case-tutkimukseen, joka pyrkii tulkitsemaan case-organisaatiossa kerättyä dataa teorian näkökulmasta. Kvalitatiivinen tutkimusmetodi valittiin, jotta case-organisaation sosiaalisiin rakenteisiin ja päätöksentekoprosesseihin voitaisiin syventyä tarkoituksenmukaisella laajuudella. Yksittäisen teorian käytön sijaan tutkielmassa pyritään tutkimaan ilmiötä aikaisempaan tutkimukseen perustuvan laajan viitekehyksen kautta. Empiirinen materiaali koostuu pääasiassa yhdeksästä semi-strukturoidusta haastattelusta S-ryhmään kuuluvassa SOK:ssa, joka tarjoaa erilaisia tukipalveluja ja strategista ohjausta S-ryhmän yhtiöille. S-ryhmä toimii pääosin Suomessa vähittäiskauppa- ja palvelualoilla.

Tutkimuksen tulokset osoittavat big datan olevan yksi monesta tekijästä siirtämässä controlleria kohti strategisempaa roolia organisaatioissa. Uudet datan lähteet edellyttävät kehittyneempää analytiikkaa ja automatisaatiota, jotka karsivat avustavia talouden tehtäviä. Controllerit eivät kuitenkaan ole kasvattaneet vaikutusvaltaansa strategisissa päätöksissä hyödyntämällä big dataa. Puutteellista liiketoiminnan ymmärrystä pidettiin merkittävimpänä esteenä controllerin laajemmalle roolille strategisessa päätöksenteossa ja analytiikan hyödyntämisessä näissä päätöksissä.

Controllerit eivät ole eturintamassa big datan hyödyntäjinä. Sen sijaan, että controllerit hyödyntäisivät enemmän data-analytiikkaa, tutkimustulosten perusteella vaikuttaa todennäköisemmältä, että data-analyytikot ottaisivat vastuulleen yhä enemmän controllerien nykyisiä tehtäviä. Analyytikot keräävät ja analysoivat taloudellista tietoa jo tänä päivänä, joten perinteisiä johdon laskennan tehtäviä on vaivattomasti siirretty analyytikoille. Toistaiseksi controllerien laskentatoimen ja kirjanpidon osaaminen kuitenkin erottaa heidät muista ammattikunnista. Pysyäkseen relevantteina ja laajentaakseen rooliaan strategisessa päätöksenteossa controllerien tulisi keksiä keinoja hyödyntää sekä uusia että olemassa olevia datan lähteitä merkittävissä tulevaisuuteen suuntautuneissa päätöksissä. Tämä edellyttää liiketoiminnan kokonaisvaltaista ymmärrystä ja tiivistä yhteistyötä muiden ammattilaisten kanssa.

Avainsanat big data, strateginen päätöksenteko, controller

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1. INTRODUCTION

1.1. BACKGROUND OF THE STUDY

Collection and analysis of data is expanding at an exponential rate (Warren, Moffitt and Byrnes, 2015). In their 18th annual CEO Survey, PwC (2015) found that CEOs regarded data mining and analytics the second-most important strategic technology just after mobile technology. 85 percent of the studied CEOs thought data analytics has a high value for their businesses. Companies are already using insights from newly available data sources in defining their technology and strategy (Davenport, 2014). For many organizations, collection and analysis of data from new sources has become a necessity in understanding emerging trends and differentiating from competitors with superior knowledge (Bhimani & Willcocks, 2014).

Recently, the term big data has been used to describe data sets that are so large that they require advanced data management and visualization technology. The huge volume, high velocity and large variety are attributes that separate big data from 'traditional' data and business analytics (Chen, Chiang and Storey, 2012). Big data and advanced analytics have been widely discussed in information technology literature in recent years. However, the phenomenon has received surprisingly little attention among the management accounting academia, considering that big data has the potential to change the managerial accounting practice and shift controllers to a more strategic role by providing more timely information at a faster rate (Bhimani & Willcocks, 2014; Warren et al., 2015).

In Finnish management accounting literature, the term controller is used to describe a management accounting professional who acts as an adviser of the company or profit center and provides the financial perspective to management decision making (Granlund & Lukka, 1997). However, in the international context, the term management accountant is used more often to describe a professional in a similar role. As the literature review of this thesis is based on both Finnish and international literature, both terms appear and are used as synonyms.

Controller's role in management decision making has been a subject of research for decades. According to both international and Finnish managerial accounting research, a change has

been noticed towards a more business- and future-oriented controller (Granlund & Lukka, 1998b; Vaivio & Kokko, 2006). Instead of an isolated beancounter or watchdog, the modern controller is expected to actively participate in management decision making and act as a business partner to the CEO or unit manager.

One of the reasons for controller's role change is the development of technology and more effective IT systems (Järvenpää, 2001). Advanced business intelligence, enterprise resource planning systems and data analytics have reduced controller's manual routine work and freed time for more future-oriented tasks such as business and process development. New analytics tools also enable deeper and faster analysis of accounting information that can be used to identify trends and alter business decisions (Bhimani, 2013). When information systems are changed, the logic of accounting is evaluated and possibly becomes subject of change as well (Granlund & Malmi, 2002).

Education and expertise in the fields of data mining and information system development are highly valued by organizations and the demand for data analysts is increasing. Consequently, experts in data analytics are expected to have more influence and power in organizations whereas other professions face the risk of becoming marginalized (Arnaboldi, Busco and Cuganesan, 2017). However, big data can help the accounting profession remain relevant (Warren et al., 2015). According to Bhimani & Willcocks (2014), advances in data, information management and technology are contributing to the trend of management accounting acquiring a larger role in strategic decision making.

Because of big data analytics, information traditionally discarded by information systems can now be linked to financial figures and utilized in decision making (Bhimani & Willcocks, 2014). Controllers have an opportunity to lead changes enabled by big data in traditional management accounting tasks, such as budgeting, management control system development and working capital management. With new possibilities to leverage more sophisticated and widely sourced data, controllers can play a central role in restructuring and strategy formation (Bhimani & Willcocks, 2014). It is crucial for controllers to adjust their responsibilities in terms of data collection and analysis to help companies gain competitive advantage (Nielsen, Jacobsen and Pedersen, 2014).

1.2. OBJECTIVES, METHOD AND CONTRIBUTION

As a very current phenomenon, big data has not been present for long in management accounting literature but its potential impact on the finance function and management accountants has already been discussed in the last few years. Despite this, there has been little empirical evidence on the impact of big data on management accountants. There is a need for more accounting academics to study a subject which has major implications for organizational decision making and accounting professionals supporting managers. Furthermore, advancement in IT and data analytics as a factor in controller's development towards a more strategic role in organizations has received limited attention. *The purpose* of this thesis is to investigate the impact of big data on controller's role in organizations and whether the phenomenon is furthering the trend of controllers playing a larger role in strategic decision making.

This study aims to shed light on the future of the controller's profession. Various organizational functions face new challenges as companies look to find financial value from access to new data sources and analytics tools. Management accountants should be aware of the opportunities and risks that big data offers. A very relevant question for both accounting practitioners and academics is whether management accounting is becoming marginalized by data specialists and operational managers or will controllers increase their influence by leveraging big data in financial analysis and strategic decisions. Are controllers forced to become information specialists in the new data-driven business environment? What are the factors influencing controller's ability to leverage big data in strategic decision making?

This thesis is based on a qualitative case study that aims to provide a theoretically informed interpretation of field data. Despite the novelty of the big data phenomenon, there are hypotheses on its impact on management accounting. Instead of testing a single existing theory, the thesis studies the phenomenon through a framework created by prior literature. Searching for empirical evidence to support the constructed theoretical framework is a common limitation and threat to the reliability of case studies. Thus, this qualitative study aims to act as a reality check to test the hypotheses of prior literature, not necessarily to confirm them.

The empirical material of the case study consists of nine semi-structured case interviews conducted in SOK, which is a part of the S Group, a network of largely Finnish companies operating in the retail and service sectors. SOK serves various S Group cooperatives nation-wide with various service functions such as procurement and financial support services. It is also in charge of strategic guidance of the S Group and the development of its different business areas.

There were several reasons for choosing SOK as the case organization. First, retail represents a classic example of a data-driven industry, where big data is already utilized. Second, as one of the largest players in the Finnish retail business, the case organization has the resources to invest in advanced analytics and third, it has publicly emphasized the value of big data for future success in the competitive retail market.

In addition to controllers, experts in data analytics were interviewed to provide more insight on the use of big data in the organization. They also provided an outside view on the role of controllers in relation to data analytics. The point of conducting semi-structured interviews was to be able to guide the interviews to the right direction to focus on the relevant research topics and ensure the validity of the empirical evidence. Careful planning was also required to ensure the benefits of big data were not overemphasized by the interviewees and that challenges were also discussed in detail.

The scope of this study is limited to management accounting and the role of management accountants. It will not discuss big data's impact on financial reporting or auditing when it is not relevant from the management accountant's point of view. The aim is also not to go into technical detail about big data analytics and applications. The basics of the phenomenon will be covered in the literature review, but the focus of the study is on the role of controllers and the opportunities big data presents to them.

To contribute to the vast body of research on the changing role of management accountants, this study focuses on controller's role in strategic decision making, which refers to future-oriented decisions that address complex issues and involve large amounts of organizational resources (Amason, 1996). Specific descriptions of the strategic decision-making processes and controllers' role in them are limited in literature. This perspective was chosen since the

big data phenomenon is expected to push management accountants towards a larger role particularly in strategic decisions (Bhimani & Willcocks, 2014; Nielsen et al., 2014; Warren et al., 2015). It provides a specific framework to study the role of modern day controllers.

1.3. RESEARCH RESULTS

The research results indicate that big data is one of the many factors forcing controllers towards a more strategic role in organizations. New sources of data require more advanced analytics and automation, which are expected to eliminate some of today's assisting accounting tasks. Consequently, the need for controllers in traditional management reporting and cost control roles will most likely decrease. However, controllers have not leveraged big data to increase their influence in strategic decision making. Lack of business understanding was identified as the most significant factor that prevents controllers from participating in strategic decision making and utilizing advanced data analytics in these decisions.

Controllers are not in the forefront of leveraging big data in strategic decision making. Experts in data analytics are required to organize and analyze most unstructured data, which increases the dependency of other professionals on data analysts. Instead of controllers acquiring a larger role in data analytics, the research results indicate that it is more likely that data experts acquire the tasks of controllers. As data analysts are already collecting and analyzing financial information, it appears that traditional accounting tasks can be effortlessly transferred from controllers to data analysts. Currently, however, controllers' knowledge of accounting principles differentiates them from other professionals. To remain relevant and continue the expansion towards a more strategic role, controllers must find ways to leverage both new and existing sources of data in long-term business decisions. This will require a holistic understanding of the business and close cooperation with other professionals.

1.4. STRUCTURE OF THE THESIS

The thesis consists of five chapters in addition to the introduction. In the following chapter, a literature review will be presented as a theoretical framework for the study. It consists of three parts: a description of controller's role change in management accounting literature, a

brief review on the concept of big data and its use in business organizations and a review on the impact of big data on controller's role in strategic decision making as it has been discussed so far in management accounting research. The first two parts serve as context to the third, which is covered most extensively as it relates directly to the research objective of the thesis.

In the third chapter, the used methodology with its pros and cons is assessed in detail. First, the case study is analyzed as a research method. This includes explaining the reasons for the chosen method and the theoretical background of qualitative case studies. Second, the reliability, validity, generalizability as well as limitations of the study results are analyzed. The fourth chapter of the thesis covers the case company introduction and findings from the field interviews in the case organization. The findings are divided into two parts: controller's role in the organization and big data's impact on the controller's role.

The fifth chapter of the paper analyzes the research findings in the light of the previously constructed theoretical framework. Similarly to the previous chapter, it is divided into two parts. First, controller's role is discussed and second, the impact of big data on controller's role in strategic decision making is analyzed in relation to prior research. This chapter aims to provide answers to the research questions. The final chapter of this thesis includes a conclusion of the research results, limitations of the study and recommendations for further research.

2. LITERATURE REVIEW

2.1. CONTROLLER'S ROLE CHANGE

In the Finnish context, the term controller refers to a management accounting professional who acts as an adviser of the company, divisional or profit center management (Granlund & Lukka, 1997). Controllers usually work in profit centers instead of a centralized accounting function. However, the usage of the term differs from one country to another. In foreign literature, the term management accountant is used more often for a professional with similar tasks. In the USA, controllers are usually senior employees responsible for both financial and management accounting (Granlund & Lukka, 1998b). This is not the case in Europe or in Finland, where controllers typically do not have statutory financial reporting responsibilities.

Controllers' tasks differ significantly between organizations. Industry, organizational structure and management preferences influence the role and tasks of the controller (Rouwelaar & Bots, 2008). According to Granlund and Malmi (2002), the most important task of the controller is to assist managerial decisions from a financial perspective and make sure this information is available to all members of the organization. Common controller tasks include production and analysis of financial information, accounting system development, budgeting and management reporting (Burns & Baldvinsdottir, 2005).

2.1.1. Controller's role expansion

The profession of a controller has developed from an accountant as information technology has evolved and business environments have become more complex (Friedman & Lyne, 2001). Traditionally, many controllers have been described as 'beancounters' or 'watchdogs' of their profit centers (Granlund & Lukka, 1997; Byrne & Pierce, 2007). Although not recognized by all accountants, this stereotype depicted controllers as conservative people that are only interested in precision and form, instead of content (Vaivio & Kokko, 2006). A typical beancounter had little understanding of business and was solely interested in the process of financial information production.

Since the 1980s, there has been a discussion in literature about management accounting becoming more business oriented. In their 1997 article, Granlund and Lukka stated that transition in Finnish management accounting culture from beancounters to change agents has occurred. Controller's role expanded to include tasks requiring more business understanding and strategic decision making (Granlund & Lukka 1998b). However, historically oriented tasks were still a part of the job (see Figure 1).

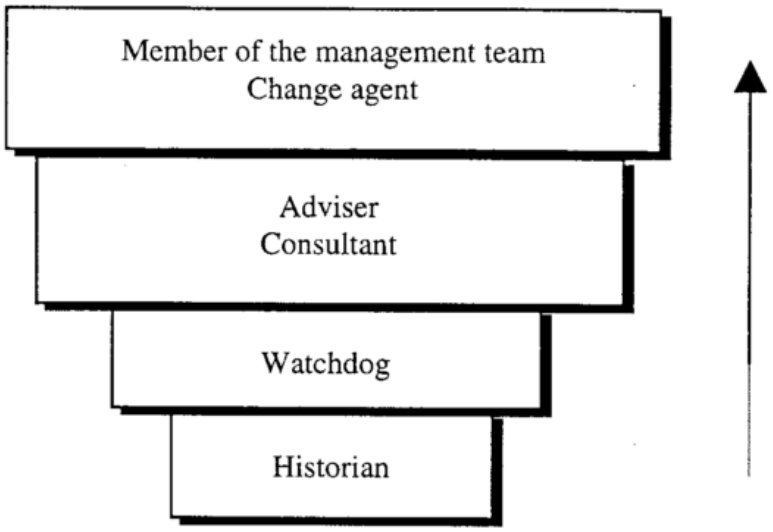

Figure 1. The expansion of management accountant's job description (Granlund & Lukka, 1998b, pp. 187)

Vaivio & Kokko (2006) studied controller's role in Finnish organizations and did not recognize the beancounter metaphor as an accurate description of the modern controller. They found that controllers have developed a middle-role between a beancounter and an active change agent who seeks to take strategic responsibilities and organizational initiative. Traditional watchdog tasks such as monitoring financial performance and spotting errors were still present but there were also clear indications of business orientation and social networking. (Vaivio & Kokko, 2006)

2.1.2. Reasons for role change

Cultural, economic and technological factors have influenced controller's role transition. Järvenpää (2001) divides these factors into three categories: new management accounting innovations, the human dimension and accounting information systems. The first category refers to new management accounting techniques such as activity-based costing, life cycle

costing, balanced scorecard and customer profitability analysis, which could as such enhance business orientation of the management accounting function. Human dimension includes the role of management accounting both as a function and as an individual. The discussion and propagated change has resulted in a cultural transition and identity transformation from quantitative orientation towards business orientation. (Järvenpää, 2001)

The third dimension refers to more effective accounting information systems such as databases, data warehouses, ERP-systems and consolidation packages (Järvenpää, 2001). Routine controller tasks can be done more efficiently, and larger databases handled quicker. Reporting has thus become more flexible, real time basis and multidimensional. Large data warehouse type of integrated information systems could give room for accountants to provide more profound analysis and decision support (Granlund & Lukka, 1998b). In general, more advanced information management has enabled the controller to focus more on business decisions rather than routine reporting duties.

According to Byrne & Pierce (2007), the role expectations of management accountants are influenced by increased market competition, complexity of operations and changes in strategy and structure of operations. Management accountants' cost control analysis skills have become more valuable to organizations due to an increased focus on cost competitiveness. On the other hand, the popularity of accounting function's decentralization in organizations has resulted in more cross-functional cooperation and brought management accountants closer to operations. Granlund and Lukka (1998a) argue that the role of national and cultural differences is diminishing, and global pressure will lead management accounting practices closer together. Global economic fluctuations, increased competition, transnational legislation, university education and benchmarking competitors are all converging forces that bring management accounting professionals' roles closer to each other.

Simultaneously, outsourcing routine accounting tasks has freed time for more analytical and business oriented tasks. Herbert & Seal (2012) found that outsourcing core accounting tasks to a shared service center forces management accountants to justify their roles as business partners. Higher level cognitive skills are required for analysis and evaluation to support decision making. Management accountants have increasingly shifted from producers of

financial information to users as separate service centers have been established. (Herbert & Seal, 2012)

2.1.3. Identity in role change

Goretzki, Strauss and Weber (2013) define professional role identity as the stable attributes, beliefs, values, motives, and experiences that make an individual an insider of a profession. Management accountants' role identity construction process towards a business partner role was studied in organizations. By creating opportunities for change, they could enhance the legitimacy of their new role as value-adding firm members. However, to legitimize a new role, management accountants had to build a new identity for themselves even if they were given more business oriented tasks from management. The role owner's own willingness to role change was crucial, as well as showing their desire for change to their counterparts, for instance operational managers. (Goretzki et al., 2013)

Alvesson & Willmott (2002) developed a framework of identity regulation for organizational control which circles around identity work, identity regulation and self-identity. As Figure 2 shows, organizational control can be accomplished through employees positioning themselves within managerially inspired discourses about work and organization with which they identify. Thus, employee's self-identity is influenced by management's discursive practices about identity formation and transformation as well as employee's interpretive activity in reproducing and transforming self-identity.

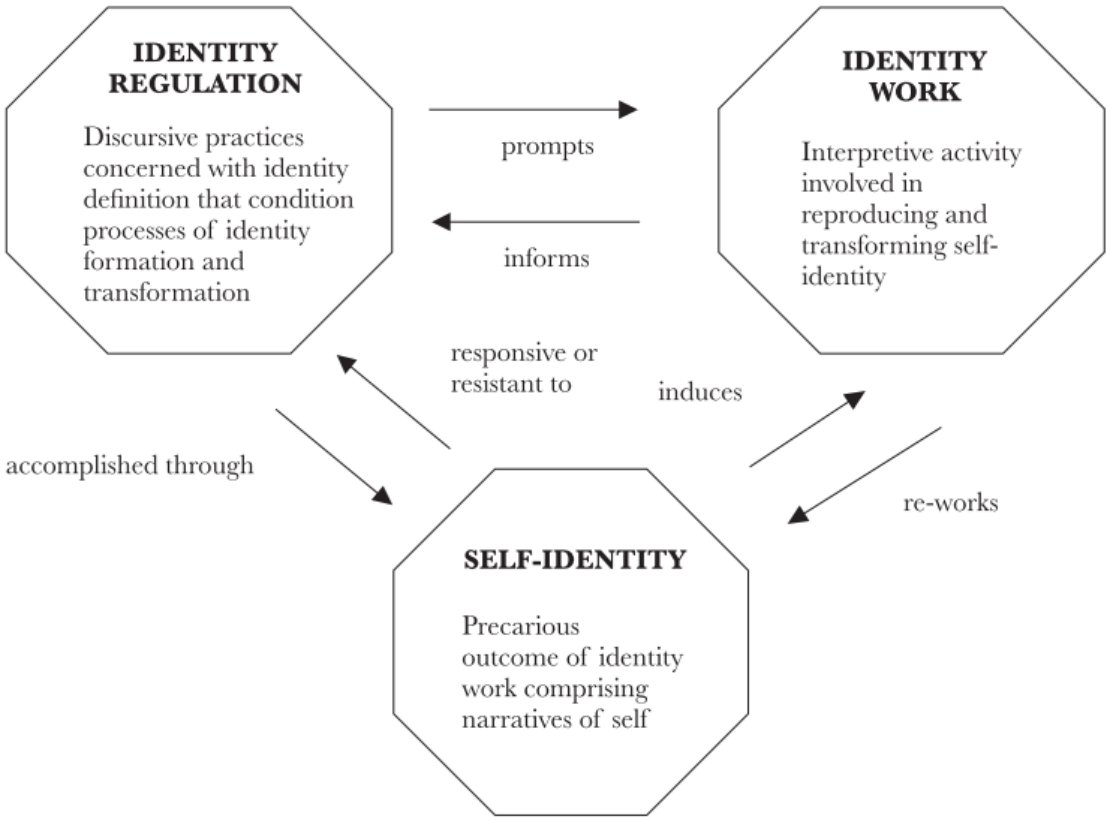

Figure 2. Identity regulation, identity work and self-identity (Alvesson & Willmott, 2002, pp. 627)

Identity work involves forming, repairing, maintaining, strengthening or revising the constructions of a sense of coherence or distinctiveness. It may be prompted or intensified by a radical change or special events. These heighten awareness of the quality of self-identity and compel more concentrated identity work. For instance, a market situation or technological change may trigger individual's role for re-interpretation. These disruptions can be caused by a mismatch between self-understandings and the social ideals in organizational or management discourse. (Alvesson & Willmott, 2002)

Furthermore, Byrne and Pierce (2007) found that managers and management accountants themselves play a large part in determining their professional role. Both operational managers and heads of the finance function have a strong influence on management accountants' work, but the role is also up to the individual for interpretation. Attitude, approachability, self-drive and personality shape the organizational role of the individual. Contradictory role expectations and discourses from managers may hinder the role development towards wider business orientation. (Byrne & Pierce, 2007)

2.1.4. Controller in strategic decision making

Nag, Hambrick and Chen (2007) define strategic management as "*the major intended and emergent initiatives taken by general managers on behalf of owners, involving utilization of resources to enhance performance of firms in their external environments*" (2007, pp. 942). Top management make strategic decisions that address complex and ambiguous issues involving large amounts of organizational resources (Amason, 1996). Strategic decision making includes environmental analysis, assessment of internal strengths and weaknesses, goal setting, comparing alternative courses of action, and development of plans to achieve the goals set (e.g. Porter, 1985; Amason, 1996).

In the normative strategy literature, organizations are depicted to be mechanistic. Decision making is viewed as a linear and orderly process where a powerful executive or management team initiates the action. Rational techniques are used to analyze environments and collective subordinate support is not questioned. Unitary and consistent preferences define the chosen action alternative. (Dent, 1990)

Organizationally grounded research has challenged this perspective by stating that complex political and structural factors, such as personalities and power, affect strategic decision making (Dent, 1990). Mintzberg, Raisinghani and Theoret (1976) found that the decision-making process is constantly interrupted, and decisions are recycled. According to Cohen, March and Olsen (1972), decisions emerge through problems, solutions, confluence of people and choice opportunities. This line of research considers strategic decision-making as disorderly and messy processes where multiple diverse sub-groups with conflicting interests contend (Dent, 1990).

Dent (1990) discusses linkages between accounting systems design and strategic decisions. His study indicates that political context and competing factions in the organization define how decisions unfold. The nature of the process depends on explicit patterns of hierarchy and authority in each organization. Dent's view is that behavioral and organizational research considers decision-making as rational or at least quasi-rational processes. In reality, less observable preparation and organizational politics play a large role. Decisions are not

necessarily discrete activities with start and end points, but work in a flow where one decision affects the next one. (Dent, 1990)

Vaivio (2008, pp. 66) describes decision-making processes as "*complex bundles of interconnected, loosely coupled events that bounce back and forth*". He argues that rational control is an illusion and that organizational targets are approximations and interpretations of local agents. Decisions are often interrupted, diverted or merged with other decision-making processes. Individuals involved in the process have opinions, biases and agendas that may not be visible to other organizational actors. (Vaivio, 2008)

High financial performance requires decision quality, consensus, and affective acceptance. However, these are often contradictory. Decision quality may hinder the development of consensus and affective acceptance may reduce decision quality. This is the paradox of strategic decision making. A diverse team of decision-makers may lack consensus and affective acceptance but are more likely to produce high quality decisions. Thus, conflict that is task oriented and focused on judgmental differences about how best to achieve common objectives contributes to decision quality. (Amason, 1996)

Carr, Kolehmainen and Mitchell (2010) compared strategic investment decision making practices in firms differing in their market orientation and performance. Well-performing market oriented firms emphasize long-term market positioning and strategic considerations in their decision making. In these firms, financial analyses have a supportive role and can even be dismissed by decision-makers. At the other end of the spectrum, restructuring firms with short-term financial pressure have tight financial targets for investments and put a lot of emphasis on short-term financial analyses and less on strategic goals. (Carr et al., 2010)

Strategic information input required from controllers differs greatly between organizations. Such information can be both monetary and non-monetary of its nature. It aims to indicate magnitude and direction instead of extreme accuracy. Investment decisions, risk assessment and strategic planning are examples of controller's most common strategic tasks. The need for strategic information often appears randomly in association with an organizational change or significant strategic investments. (Colton, 2001)

As controllers work more closely with managers, they have become more involved in strategic management (Bhimani & Willcocks, 2014; Burns & Baldvinsdottir, 2005; Järvenpää, 2007). In the modern role, controllers are more concerned about future-oriented strategic information and the firm's external environment instead of historical data (e.g. Granlund & Lukka, 1998b; Burns & Baldvinsdottir, 2005). However, prior literature provides mixed evidence on controller's transition into a business partner role and strategic decision making.

Malmi, Seppälä and Rantanen (2001) studied the practice of management accounting in Finland. They found that an increasing number of controllers work as business partners, with over two thirds consulting management regularly. Over half of the studied management accountants were involved in strategic planning. Controllers' most common strategic tasks were performance measurement, developing balanced scorecards and process improvement. However, there were still companies where traditional watchdog activities consumed most of their working time. CFOs were more involved in strategy, company restructuring, capital budgeting, risk management and reward systems. (Malmi et al., 2001)

Consistent with Malmi's findings, Rouwelaar and Bots (2008) found that controllers in the Netherlands had a larger impact on operational decisions compared to strategic ones. Bhimani's and Keshtvarz's (1999) study in the UK indicated that management accountants provide strategically important information to managers, but are usually not participating in strategic decision making. Graham (2009) found that controllers wanted to be involved in strategic management, but this was rarely the case.

Transition towards a modern controller could arise from closer cooperation between managers and management accountants (Burns & Baldvinsdottir, 2005). Lack of collective comprehension of controller's role in the organization has been one major barrier to role change. Byrne and Pierce (2007) reported that management accountants' understanding of what was expected of them was poor. Individual manager's preferences may have a significant impact on management accountant's role in the organization. Managers may be unwilling to support the role transition, because putting management accountants in charge of strategic non-financial measures could induce organizational conflicts (Vaivio, 1999). In addition to management preferences, inadequate information systems result in larger

amounts of routine financial reporting tasks, which hinder management accounting's role transition (Järvenpää, 2001; Vaivio & Kokko, 2006). Burns & Baldvinsdottir (2005) reported that lagging accounting systems were inadequate to operational managers' information needs.

2.2. BIG DATA

2.2.1. Business intelligence and big data

The term business intelligence became popular in the 1990s in IT and business literature. It was used to describe processes and software collecting and analyzing data for decision making purposes (Chen et al., 2012). In the 2000s, business analytics was introduced as "*the use of data, information technology, statistical analysis, quantitative methods, and mathematical or computer-based models to help managers gain improved insight about their operations, and make better, fact-based decisions"* (Davenport & Harris, 2007, pp. 7). Business intelligence and analytics include data processing technologies and business centric practices that can be utilized in many high-impact applications such as e-commerce, e-government, healthcare and security (Chen et al., 2012).

The massive popularity of the internet since the early 2000s has allowed search engine and e-commerce businesses to collect unique data and interact with their customers directly. Web analytics and user-generated content from social media and crowd-sourcing systems are now used to transform unstructured data into valuable information for business decision making. Opportunities are emerging from mobile phones, laptops and other sensor-based internet-enabled devices equipped with barcodes and radio frequency identification. Location-aware and person-centered operations and transactions are expected to offer new opportunities in areas of accounting, marketing, logistics, and operation management. (Chen et al., 2012)

As a result, big data has become a popular term in business literature (McAfee & Brynjolfsson, 2012; Davenport, 2014; Bhimani & Willcocks, 2014). The term has been used to describe data sets that are so large and complex that they require advanced data management and visualization technologies. Three Vs define the term and differentiate it from the broader term of business analytics: volume, variety and velocity. Volume refers to the size of the database, variety to the wide range of data types and velocity to the amount

of data added continuously. These three qualities have served as a common framework to describe big data (Chen et al., 2012).

Because of fast-paced technological development, as well as different types and speeds of data, there is no exact threshold for volume that qualifies as big data (Gandomi & Haidar, 2015). More data is now transported through internet every second than was stored in the entire internet 20 years ago (McAfee & Brynjolfsson, 2012). Data volume considered big today may be small in the future. Companies now have a chance to work with multiple petabytes of data in a single set. For instance, Walmart collects more than 2,5 petabytes of data every hour from its customer transactions and Facebook stores over 260 billion photos with storage space over 20 petabytes (Gandomi & Haidar, 2015).

Velocity of data flow is the most significant aspect of big data for many organizations (McAfee & Brynjolfsson, 2012). Micro-cameras, precision sensors and radio frequency identification tags are examples of technologies that enable real-time data collection (Bhimani & Willcocks, 2014). The velocity of data flows has increased the demand for real-time analytics (Gandomi & Haidar, 2015). Products and processes can collect and analyze information on the spot without the need for separate information systems (Bhimani & Willcocks, 2014). For instance, companies have successfully estimated customer sales before they are recorded by using location data of smartphones on the shopping mall parking lots (McAfee & Brynjolfsson, 2012).

In addition to the previously mentioned three Vs, other dimensions of big data have also been introduced in literature. Veracity of big data represents the uncertain reliability of gathered information. Dealing with uncertain and imprecise data requires persistent development of advanced analytics tools. Data flow rates are also inconsistent and have periodic peaks and troughs. This has been referred to as variability of data. Finally, the sixth V is value, which indicates the low value density of data in its original form relative to its large volumes. (Gandomi & Haidar, 2015)

For some companies, the use of big data has already become a necessity in understanding emerging trends and succeeding in the competitive environment. New types of data may unveil new products, selling strategies and create entry barriers for market entrants. For

instance, eBay alters its listings based on prior listing activity, bidding behavior, pricing trends, search terms used and purchase frequency. Similarly, Google search results are based on what previous users found useful. Data analytics development is crucial to enable management to access structured and unstructured information about market trends and customer behavior. (Bhimani & Willcocks, 2014)

Chui, Loffler and Roberts (2010) argue that the physical world is becoming an information system via the internet of things, in which physical objects, such as machines, vehicles and buildings that are connected to each other can collect, exchange and analyze data. This global web of objects may create big data that can be used to increase productivity and reduce both production and delivery costs through predictive algorithms. Simultaneously, internet-based cloud computing has enabled organizations to store and share resources at lower costs (Bhimani & Willcocks, 2014). Outsourcing applications over the internet is creating new opportunities regarding provision of accounting information in organizations.

In addition to the shift from historical data to real-time processing, big data also moves analytics away from the use of samples. With advanced analytics tools, entire sets of data can be analyzed at once and broader queries on the data can be made. Interrelationships between internally and externally sourced data that were not accessible before, now become visible. Ability to leverage real-time analysis on large data sets offers significant opportunities for organizations. (Bhimani & Willcocks, 2014)

Survey by Accenture (2014) found that the breakthrough of big data will take place in the next three years in Finland. Over half of the respondents in electronics, media, retail and machine manufacturing industries thought big data is already visible in their business. The Finnish ministry of transport and communications (Liikenne- ja viestintäministeriö, 2013) estimated that leveraging big data can improve Finland's GDP by 2,1% by 2020. However, big data use was found to be in an immature stage as businesses are still exploring ways to find the added value in it.

2.2.2. Converting data to knowledge

Most data organizations collect is unstructured and cannot be easily interpreted (Bhimani & Willcocks, 2014; Warren et al., 2015). Strategic information is increasingly received through unstructured channels such as social media and internet-based gadgets. Enterprises have invested in processing data but organizational processes that drive value from data have been given less attention (Bhimani & Willcocks, 2014). Gandomi & Haidar (2015) state that big data is useless by itself. Efficient processes are required to transform large amounts of diverse data into useful insights.

Information technology literature has a hierarchical view of data, information and knowledge. Data is seen as raw numbers or facts that are processed to information which then becomes knowledge when it is authenticated (Alavi & Leidner, 2001). As such, raw data does not exist without already being influenced by individual's knowledge as it is identified and collected. Bhimani and Willcocks (2014) argue that understanding the relationship between data, information and knowledge is crucial to accounting systems design. Data can be viewed as a record, information as a message and knowledge as a model of how something works.

The difference between information and knowledge is that knowledge is in the mind of individuals. "*It is personalized information related to facts, procedures, concepts, interpretations, ideas, observations, and judgements*" (Alavi & Leidner, 2001, pp. 109). Knowledge can also be defined as the agent's expectations that are modified by the arrival of information. Only an agent with knowledge can form information from data. According to Bhimani & Willcocks (2014), big data and business analytics can help with this conversion process.

Identifying and leveraging collective organizational knowledge to help an organization achieve its goals is referred to as knowledge management (Alavi & Leidner, 2001). The four basic processes of knowledge management are creation, storage, transfer and application of knowledge**.** Knowledge management projects aim to visualize knowledge and build a knowledge-intensive culture that encourages knowledge seeking and sharing (Davenport &

Prusak, 1998). Such projects often involve building knowledge infrastructure such as a technical information system or giving employees time and space to collaborate.

Big data analytics can be seen as a sub-process of data insight extraction and knowledge management (Gandomi & Haidar, 2015). Computational techniques derived from big data technology can be utilized to make huge datasets useful for decision making (Warren et al., 2015). Statistical techniques that are more suitable to mining big data are likely to be developed since most big data is noisy, interrelated and unreliable (Gandomi & Haidar, 2015). As new analytics go beyond samples, business intelligence can be obtained from less organized and trustworthy data. Use of unstructured data gives organizations opportunities to create a more informed strategy and offer faster service (Bhimani & Willcocks, 2014).

2.2.3. Challenges in using big data

Information technology and management accounting literature shares the opinion that big data does not necessarily lead to better decision-making (e.g. Chen et al., 2012; Bhimani, 2013; Quattrone, 2016). Warren et al. (2015) define three limiting factors that entities face when applying big data techniques: quantity, quality and accessibility. These refer to lack of data, irrelevant or unreliable data and insufficient expertise in extracting information. Thus, organizations should be able to identify big data, assess its suitability for the issue at hand and decide whether the analyses should be outsourced.

Most organizations that utilize big data do not know how to get value or information from it (e.g. Bhimani & Willcocks, 2014; Appelbaum, Kogan, Vasarhelyi and Yan, 2017). Business environments with massive volumes of data do not translate to knowledgeable environments (Bhimani & Willcocks, 2014). Although companies are advised to engage in big data, changing current systems might be challenging as they tend to be fragmented and known to few experienced individuals. For these reasons, traditional historical data may still be required as much as big data (Bhimani & Willcocks, 2014).

Organizations may encounter information overload and statistical analysis problems (Bhimani & Willcocks, 2014). According to Appelbaum et al. (2017), complex data extracts, data fluctuations, data duplications, data security issues, and handling multiple analytics tools simultaneously are some of the most common challenges in organizations utilizing big

data. Since traditional analytical techniques are often based on samples, they may not be applicable in big data context, where mass analysis is required. This transformation to new methodologies may be time consuming and prone to errors.

Granlund and Malmi (2002) studied enterprise resource planning systems and discussed the issue of management by facts. Management can increasingly rely on factual data as information technology advances. However, managers have for long received and produced more information than they can use. From the information user's perspective, it seems like new technology cannot remove the fundamental problems which derive from human and social issues. They question whether managerial work changes at all when new technologies are implemented. (Granlund & Malmi, 2002)

Links between knowledge, action and the exercise of judgement in decision-making have also been discussed in literature. There are concerns that the digitization of accounting and focus on data analytics will lead to the loss of communication and dialogue. In traditional accounting, decision-makers exercised judgement all the way from the collection and construction of knowledge to execution of action by individuals. Knowledge was not ready to be used before the issue was discussed and a reasonable compromise reached. (Quattrone, 2016)

In the digital age, individuals may put too much emphasis on what the data shows and jump to wrong conclusions more quickly. Accounting numbers, their visualizations and predictive models are valued to the point where human judgement is left to a minimum. The dream of perfect information is unrealistic, and politics and egos may affect decision-making negatively. This may lead to divisions and loss of dialogue between functions and individuals. In the context of big data, accountants and managers should seek for reasonable, instead of perfectly rational, choices. (Quattrone, 2016)

Morabito (2014) summarizes four main challenges with implementing big data to find business value. First, information sources must be converged with each other. This means that an integrated and high-quality data asset needs to be constructed from various information sources. Secondly, the IT organization must support the storage and insight extraction of both structured and unstructured data. Third, flexible access to the data and

analytics tools should be implemented across the enterprise. Finally, IT and top management must agree on major investments for innovation and development of big data analytics. (Morabito, 2014)

2.3. IMPACT OF BIG DATA ON CONTROLLER'S ROLE

2.3.1. Big data in management accounting

Plenty of research has been published on how new enterprise resource planning and advanced information systems have impacted management accounting (e.g. Granlund & Malmi, 2002; Rom & Rohde, 2007; Kallunki, Laitinen and Silvola., 2011). However, little literature discusses the role of advanced data analytics and big data in management accounting. Information systems face transformation as volume, variety and velocity of data is increased in organizations (Chen et al., 2012). According to Granlund & Malmi (2002), when information systems are changed, the logic of accounting is evaluated and possibly becomes subject of change as well. The impact of big data and advanced analytics on management accounting is discussed in this section.

Organizations are assessing the potential of financial information change**.** Data can now be shared across geographical boundaries in multinational corporations. As examples, Microsoft and BP standardized their accounting functions globally with the help of their service providers. They moved their database to the cloud and developed business analytics that helped shift accounting to a more strategic role in the organization. It reduced operating costs significantly, but also provided added value by making financial analytics more accessible in decision making situations. (Lacity & Willcocks, 2012)

Managers increasingly demand real-time feedback about consequences of their decisions and actions. Management accountants can use newly accessible data for new performance measures and to improve the company's management control system. For instance, internal e-mails may correlate with the effectiveness of internal business processes, vocal tone from customer service calls with customer service quality or time spent on the phone with worker productivity. Big data can also help discover employee behaviors correlated with specific goal outcomes. Organizations may now discover new motivational measures and identify harmful ones. New technology enables excessive employee tracking, but enterprises need to

be careful with privacy laws and prevent suppressing worker creativity and motivation. (Warren et al., 2015)

The use of image and video data can add important information to accounting records. Examples of these methods include surveillance footage of when a restricted-access area is entered, to track worker productivity, video of inventory to monitor real-time quantity changes to measure throughput and identify bottlenecks, and video of the condition of property, plant, and equipment to assess potential impairment issues. Interviews with construction site engineers can serve as audio data streams to offer evidence of property asset value and estimated period of benefit. Business disclosures incorporating nonfinancial information provided by big data sources such as video and image, can even help in investment quality assessment. (Warren et al., 2015)

Big data can also be used to improve budgeting processes. Traditional budgeting may not be flexible enough in a fast-paced information economy. For this reason, organizations have begun using so-called beyond budgeting techniques. This includes using alternative information sources for operational planning, goal-setting, and strategy formation. New data streams, such as climate, satellite, census, labor, and macroeconomic data could be used in all these tasks. (Warren et al., 2015)

With the internet of things, organizations receive feedback from machines or sold products directly without the need for separate human involvement and analysis in the middle. This real-time information can be shared with customers and used for proactive and faster customer service. For accountants, new ways to manage working capital have become possible. Current conditions of inventory and sold products can be more closely monitored and action taken. As such real-time information was not previously available, the accounting function can undertake a new role as a receptor and assessor of working capital information for constant analysis and decision making. (Bhimani & Willcocks, 2014)

2.3.2. Controller's role in data analytics

Because of technological advances and lowered costs of business analytics, finance professionals may acquire new roles as information specialists. According to Bhimani and Willcocks (2014), management accountants do not have to be technical experts of data

analysis, but they need to understand its opportunities and implications for the financial intelligence they produce. Big data requires skills in analyzing both structured and unstructured data from diverse channels. With the ability to leverage more sophisticated and widely sourced data, accountants can play a central role in restructuring and strategy formation. (Bhimani & Willcocks, 2014)

According to Warren et al. (2015), big data will help the accounting profession remain relevant. However, organizations need to use data scientists to turn data into packaged information. Management accountants' knowledge is useful only after experts in data analytics have mined, transformed and analyzed the data. After this, management accountants can prove their value by using the information to develop management control systems and budgeting processes. (Warren et al., 2015)

Partly contrary to Warren et al. (2015), Pickard & Cokins (2015) argue that accountants should play a larger role in data mining and analytics in their organizations. Companies need to be involved in business analytics to remain competitive. Analytics tools now have an increased accessibility and accountants already have a reputation for understanding data quality. In the past, accountants lacked technical skills to leverage data mining and analytics technology. Recently, new user-friendlier tools have enabled accountants to produce strategic information from the analyzed data. Pickard & Cokins present an example of customer profitability analysis where accountants analyzed a large customer costing and profit dataset providing insight for decision-making that would not have been found without accounting knowledge.

Al-Htaybat & Alberti-Alhtaybat (2017) found that accountants have tacit knowledge and practical experience that cannot be replaced by experts in analytics. This tacit knowledge refers to a 'feel for the numbers' as well as accounting principles and values brought by accounting education and practice. Accountants were seen as more conservative in decision making especially in relation to prospective information. Accountants have a particular way to view and analyze data, whereas data scientists possess knowledge and interpretational qualities that complement each other and can benefit organizations when combined in cross-functional teams. (Al-Htaybat & Alberti-Alhtaybat, 2017)

Data analysts with skills in database analysis, visualization creation and tool selection are in high demand and their influence is expected to increase in organizations. To remain valuable, accountants should concentrate on learning cognitive skills that are required in effective big data analysis. Understanding limits of measurement representation, subjectivity of insight, integrating data sets and various statistical challenges is the key to differentiating from others working with data analytics. Accounting professionals should act as informed skeptics and challenge analysis regarding the topics that influence the business. (McKinney, Yoos and Snead, 2017)

Accounting literacy has become easily transferable to non-accountants, such as information system specialists because of advanced enterprise resource planning systems. However, the roles of accountants and information system experts are hybridized in both directions. Accounting department tasks may be transferred to the IT function and IT work, such as information system development and data management, to accountants. The specific socio-organizational context determines how the hybridization takes place and which profession it favors. (Caglio, 2003)

The hybridization of management accounting techniques by medical professionals was studied by Kurunmäki (2004) in Finland. It was found that instead of focusing on abstract knowledge, attention should be paid to the roles of techniques, and their mobility between professions. Management accountants' calculative skills and tools, such as pricing and cost analysis, were acquired by medical professionals without a jurisdictional battle or competition. As techniques traditionally considered to belong to management accountants were effortlessly transferred to medical experts, Kurunmäki (2004) argues that management accounting should be considered a craft rather than a profession. In any professional field, further analysis of techniques would enable forming a more complete view of interprofessional relations. (Kurunmäki, 2004)

Quattrone (2016) emphasizes the value of dialogue in an increasingly data-driven business environment. Larger amounts of accessible data will result in an even more complicated web of data users and decision-makers. Those in control of databases and technologies will have more influence over less data-driven individuals. However, discussion and debate will hold its importance in modern-day organizations. Divisions between the controllers of data and

the controlled should be avoided. Management accountants need to focus on establishing dialogue to achieve reasonable decisions instead of looking for the ultimate truths in data. (Quattrone, 2016)

2.3.3. Impact of big data on controller's role in strategic decision making

Information management and big data analytics are increasingly important in management accounting (Appelbaum et al., 2017; Bhimani & Willcocks, 2014; Quattrone, 2016). According to Bhimani & Willcocks (2014), the impact of qualitative, quantitative, graphical and interactive information output will have an impact on the work content and style of management accountants. Senior accounting executives' influence has expanded from financial matters to broader strategic choices over the last decades. Advances in data, information and technology are now furthering this trend (Bhimani & Willcocks, 2014).

Big data has meant that information traditionally discarded by information systems can now be linked to economic transactions and utilized in decision making. As previously mentioned, organizations can now gather data through new channels, such as social media, smart phone applications and other internet-based gadgets. Real-time reactions are needed for operational issues while activities triggered by strategic information will need to be handled separately. The data often comes in unstructured form and the challenge is to turn it into structured information that can be analyzed and used in both strategic and operational decision-making. Finance functions and management accountants can play a central role in this transformation process. (Bhimani & Willcocks, 2015)

Bhimani (2013) states that rethinking the potential of financial information change is now viewed as desirable. Finance functions see new uses for resources and ways of pursuing corporate strategy because of advanced analytics. Accounting information with deeper and faster analysis is being used to identify new trends and alter business decisions. This has resulted in more accounting managers going beyond their traditional roles to guide decisions about corporate operations and deliver financial integrity. (Bhimani, 2013)

Big data storage, analytics and cloud services are increasingly outsourced to service providers to leverage their experience and knowledge in these new technologies. Similarly,

accounting processes such as payroll and transaction processing are often handled in shared service centers or by third parties. Only activities with value adding work are kept in-house close to business decision makers. This would indicate that management accountants need to be aiming for leading roles in strategy, decision making and driving change to remain indispensable. In information management, accountants should be able to translate insights from big data analytics into value-adding business decisions that cannot be automated or done by third parties. (Bhimani & Willcocks, 2014)

The role of the management accountant changes as businesses require more future-oriented data to assist in strategic decision-making. Controllers must adjust their responsibilities in terms of data collection and analysis to help companies gain competitive advantage. Reporting historical financial information such as financial statements and monthly reports may not be necessary for managerial decisions. To help top management in decision making, management accountants will be expected to provide predictions of consequences for uncertainty and risk in decisions. This calls for improvement in statistical and mathematical skills of management accountants to map the future of the organization with less uncertainty. (Nielsen et al., 2014)

Appelbaum et al. (2017) specifies opportunities brought by big data for management accountants to contribute to strategic decisions. For instance, predictive analytics from internal sources such as company databases can provide predictions of future material supply cost development. With these results, prescriptive analytics can find optimal solutions and their likely outcomes for decision-making situations, such as vendor choice. As an increased amount of information is available about different vendor alternatives, a management accountant can suggest the most beneficial vendor for the company in the long run. (Appelbaum et al., 2017)

Similarly, management accountants can use predictive analytics to support decision making in acquisition of new technologies increasing productivity and work efficiency. External data, such as news and customer reviews, could be analyzed to compare different information systems in ways not previously possible. Even long-term consequences of investments into innovation and labor training can be modelled. In other words, management accountants are expected to identify both internal and external drivers of financial

performance. With adequate skills to utilize advanced analytics and assess the quality of the data, they can make rationally justified decisions on the go without time-consuming manual research. However, management accountants are still largely involved with descriptive analytics and not yet taking advantage of opportunities offered by predictive and prescriptive tools. (Appelbaum et al., 2017)

Bhimani and Willcocks (2014) argue that the sequential path from strategy to structure and information system design is disappearing. Technological choices and strategy formation may be responses to a new financial information provision. For instance, big data and new analytics tools may unveil changes in cost mix of products and shifts in cost behavior that can quickly be translated into renewed business strategies. Finance and accounting professionals will be expected to notice these changes in accounting records and act upon them while simultaneously redefining organizational strategy. (Bhimani & Willcocks, 2014)

Furthermore, decision making and action are increasingly integrated in an organization embracing data analytics. In a digitized economy, managers can act whilst planning their next move. Decision making and action are not necessarily sequential, and organizational thinkers and actors, such as controllers, may not be separate groups anymore. Objectives can be defined simultaneously with the execution of a desired action. Thus, strategic processes and information management are closely intertwined. The reduced distance between thought and action creates a need to redesign performance metrics and management incentive systems. To construct a reward system in a fast-paced digital environment, organizations will need accountants that understand the new demands for performance metrics, management assessment parameters and incentives. (Bhimani & Willcocks, 2014)

In addition to management control systems, new data sources provide an opportunity to redesign budgeting processes. Both incentive system development and budgeting play a significant part in aligning organizational objectives with performance metrics and implementing strategy throughout the organization. Management control system design and budgeting are already considered management accounting processes in many companies. Thus, accounting professionals have an opportunity to be in the forefront of utilization of big data in redesigning these systems and helping management implement their organizational strategy. (Warren et al., 2015)

Schneider, Dai, Janvrin, Ajayi and Raschke (2015) argue that accountants can contribute more in tasks concerning data analytics, since they are detail-oriented and have knowledge of the business as a whole. There is potential for finance professionals to transform into information management experts as technology advances, more sophisticated analytics tools are available, and costs of such intelligence are lower (Bhimani & Willcocks, 2014). Real-time and more widely sourced information in accounting reports can be used to change corporate strategy instead of only to support it. This points to accounting professionals having a more significant role in more future-oriented strategic tasks (Bhimani & Willcocks, 2014).

Management accountants already have an understanding of financial flows of R&D, sales and various other key processes. Big data enables the integration of data from all these functions. Management decisions regarding revenue generation, cost control and product strategies can benefit from datamining, data exhaust assessment and other data analysis techniques. Management accountants could have a central role in addressing the issues of each function if the organization has internalized the potential of big data. Instead of focusing on historical data, accountants need to give more attention to emerging trends. Asking the right questions requires experience with big data but financial perspective is also needed, which separates accountants from data scientists. Knowledge in both fields is needed to drive strategic value from the data. (Bhimani & Willcocks, 2014)

Despite the large amount of predictions regarding big data's impact, there is little empirical evidence of radical change of the finance function and management accountants towards using these new information possibilities (Bhimani & Willcocks, 2014). In general, enterprises investing in big data do not know how to get value or information from the data gathered. According to Sangster, Leech and Grabski (2009), managerial accounting has not developed to take advantage of advanced data analysis techniques. Management accountants may not have the knowledge of analytics and big data required (Appelbaum et al., 2017).

According to Arnaboldi et al. (2017), accounting can be used to achieve a shared understanding of the value of big data and unite professional groups to leverage it. However, accountants often do not see big data as a resource for the organization. Even if they

understand the potential of big data, they may not take the lead as expected by many accounting academics. From an accounting perspective, where all variables and models should fit together, the complexity of big data is often seen as a burden instead of an opportunity**.** In addition to the amount of information they already must deal with, the pressure linked to financial reporting may also hinder accountants from taking a more strategic role. (Arnaboldi et al., 2017)

Being a true business partner to management requires understanding the business (Payne, 2014). On one hand, big data and analytics provide opportunities to understand a business and its customers better. On the other hand, accountants may find it more difficult to comprehend operational activities and connections between them. This may happen in the case of outsourcing and automation, which make processes less visible. Fixing or developing the system may thus become more challenging for management accountants. Being distanced from operations may hurt management accountants' abilities to support management and participate in strategic decision making. (Payne, 2014)

3. METHODOLOGY

3.1. CASE STUDY AS A RESEARCH METHOD

Qualitative case study was chosen as a research method because the study aims to dive deep into a complex management accounting phenomenon. It shall not simply list the tasks of studied management accountants or new accounting tools used. Instead, the objective is to provide a rich description of the social structures, decision making processes and interactions between diverse individuals in a unique organizational setting. Roles of management accountants could not be explained without understanding the imperfect practices and conflicting views within the organizations. Thus, the research objectives would not be met using a survey or other quantitative research method.

Quantitative research methods have dominated accounting literature for the past decades (Lukka & Kasanen, 1995). As traditional surveys and numerical data were thought to offer only a superficial view into organizational practices, a more intensive research method was looked for. Field and case studies have since been widely popular qualitative research methods in management accounting research (Scapens, 1990; Lukka & Kasanen, 1995; Vaivio, 2008). From a methodological standpoint, the two terms can be evaluated using the same criteria. In this thesis, the term case study is used to describe the study of management accounting in its organizational context.

Case studies can be viewed as a subgroup of ethnographic research methods, where the researcher collects material in the subject environment (Ahrens & Dent, 1998). The methods may include participant observation, field notes, interviews, and surveys. The aim is to provide a deep understanding of a management accounting phenomenon in its historical, social, economic and organizational context. Accounting systems can be studied as part of a unified social system, for which Scapens (1990) argues the case study method is particularly suitable.

Case studies enable refining existing theories or creating new conceptual frameworks from empirical evidence (Scapens, 1990; Ahrens & Dent, 1998). Ahrens and Dent (1998) discuss the relationship between theory and data in field research. One of the benefits of case studies

is that they enable the researcher to observe real-life practice through the glasses of prior theory and thus deepen our understanding of how accounting functions. The researcher aims to find patterns in the case material, which requires imagination and creativity. However, the researcher should be faithful to his or her observations, and move systematically from case material, through interpretation, to explanation (Ahrens & Dent, 1998).

Scapens (1990, pp. 265) has divided case studies into five groups: Descriptive, illustrative, experimental, exploratory and explanatory case studies. Descriptive case studies describe techniques, procedures and accounting systems that are currently used in practice. The second group, illustrative case studies, aim to illustrate new practices that have been implemented in organizations. In experimental case studies, researchers develop new procedures and techniques that may help accounting practitioners. Exploratory case studies are used as preliminary investigations with the objective to produce generalizations about reasons for particular accounting practices. Finally, explanatory case studies aim to explain why specific accounting practices should be or are in use. Scapens emphasizes that this list is merely an indication of different types of case studies and that there are no clear boundaries between these different methods. (Scapens, 1990)

This thesis has qualities of descriptive, illustrative and explorative case studies. It aims to find out if big data has had an impact on management accounting practice and the role of controllers in strategic decision making. The thesis provides a description of controller's role in the case company's organizational and social context. The study is also illustrative in the sense that it discusses how new analytical tools and methods are used to create value in these companies. It is important to be critical of new methods and ensure that the use of new innovations will not automatically be assumed to be superior to traditional technologies (Scapens, 1990).

Because of the novelty of the big data phenomenon, there is very little empirical evidence on its impact on management accounting or the role of controllers. Most organizations that are collecting data from new sources are in early stages of utilizing it in information systems and decision making. Thus, the thesis also has exploratory qualities, as it represents a preliminary investigation into the impact of a new phenomenon in a single case context. It aims to produce ideas and hypotheses for more empirical testing at a later stage.

Theory discovery studies rely on emerging insights from the field evidence while theory refinement has a strong foundation on prior literature (Vaivio, 2008). This thesis can be described as a theory refinement study as it has a clear theoretical starting point. Instead of testing a single existing theory, the thesis studies a phenomenon through a framework created by prior literature. The researcher must avoid subconsciously searching for empirical evidence to support the theoretical framework. This qualitative case study aims to act as a reality check to test the hypotheses of prior literature. In other words, findings of this study shall be compared to the results and predictions made in management accounting research until this day. A new conceptual framework will not be created but prior theory may be refined.

Scapens (1990) argues that studies of accounting systems often fail to understand how these systems are embedded in every day practice of organizational actors. It is important to distinguish the formal accounting systems which managers believe are in use and the way they are used in reality. With a thorough exploration of each case organization, it is possible to understand the nature of management accounting in daily practice. This includes both the techniques and procedures in use as well as the ways in which they are used. (Scapens, 1990)

Field studies let individual voices that have been suppressed in traditional quantitative research, be heard. Ahrens and Dent (1998) believe capturing ambiguities and tensions is one of the most significant benefits of field research. The contradictory ways these ambiguities are seen differ in each organization. To gain an understanding of the socially constructed phenomenon in question, it is necessary to pay attention to the social interactions and structures between individuals (Scapens, 1990).

Despite the many advantages of qualitative research, there are numerous challenges that researchers face when conducting case studies and qualitative research in general. Understanding the relationship between data and theory is not easy in quantitative research either, but particularly in qualitative studies the large set of observations makes selecting and presenting key observations very difficult (Ahrens & Dent, 1998). Finding theoretical sense from conflicting interpretations of research participants requires patience and consistency from the researcher. The quality of a case study is heavily dependent on the

skills of the researcher and can be easily influenced by personal biases (McKinnon, 1988), which are discussed in the next section.

3.2. RELIABILITY AND VALIDITY

Reliability and validity are indications of credibility in scientific research. They may be assessed differently in quantitative and qualitative research. In case studies, reliability and validity are often more difficult to verify compared to traditional survey methods. (Scapens, 1990)

Reliability refers to whether the researcher is collecting data that can be relied upon (McKinnon, 1988). As qualitative research is characterized by a mix of structured and unstructured data instead of particular research instruments, different issues should be addressed regarding reliability compared to quantitative studies (Ahrens & Chapman, 2006). Validity, on the other hand, can be defined as the relevance of collected findings. In other words, it is a question of whether the studied phenomenon is what the researcher is aiming to study (McKinnon, 1988).

McKinnon lists four threats to validity and reliability in field research (1988, pp. 37).
The first one is observer's influence on the phenomenon under scrutiny. For instance, the presence of the researcher may affect the interviewee's behavior and opinions. This problem can be avoided by making sure that the study participants understand the role of the researcher in relation to management. It means that the researcher should not be viewed as a 'management spy'. The participants should have a clear understanding of how the study is conducted. (McKinnon, 1988)

The second threat, observer bias, refers to the distorted effects of the researcher's selective interpretation. Case studies are never completely objective. Every researcher has a unique bias towards different phenomena. Cultural background, occupational training and other prior experiences have an influence on the way the observer sees and hears. This problem cannot be eliminated but can be managed. The researcher should pay attention to his or her particular biases and what can be done so that they do not contaminate collection and analysis of research data. (McKinnon, 1988)

Data access limitations are also common issues in case studies. The researcher is on site for a short period of time and does not know what has happened there before and after the visit. The phenomenon could be in an 'abnormal' state at the period of observation. The hosts may also impose restrictions on the researcher's data access. Finally, the complexities and limitations of the human mind may impact the reliability and validity of field studies. The interviewees may consciously mislead the researchers to present themselves in a favorable light. Even if being honest, people may forget past events or have their own biases towards various phenomena. (McKinnon, 1988)

Vaivio (2008) discusses implications of the data collection process on reliability and validity. He argues that the longer the researcher spends time on the research site, the less likely the study is to have deficiencies in reliability and validity. This means that the interviews should be numerous and extensive enough for the researcher to gain a deep understanding of the organizational context and phenomenon in question. However, keeping a moderate distance to the studied organization is recommended. Data triangulation between different sources can also enhance the reliability of gathered evidence. Discrepancies between different data sources regarding the same topic can expose relevant information about the studied phenomenon. (Vaivio, 2008)

This study did not limit the research evidence to recorded interviews. Internal documentary material as well as publicly available information and observations made within the company were used. To address the issue of validity, the field work included nine interviews (see Appendix 1) extensive enough to answer the relevant research questions and to achieve the objectives of the study. Additional questions were presented via e-mail or a phone call if a relevant research question was left unanswered in the first interview session. The case organization and its history were thoroughly studied beforehand using publicly available material such as annual reports, investor presentations, press releases and newspaper articles. The interviewed employees' positions and organizations they manage were also researched beforehand. These preparations enabled the researcher to have a more holistic understanding of the studied organization and freed time in the interview sessions to the relevant research topics.

In this study, the case company is a large retail and travel industry player and well known among consumers in Finland. This raises questions about researcher bias since qualitative case studies are always influenced by the researcher's preconception of the studied organization (McKinnon, 1988). However, it is beneficial to the reliability of the study that the researcher acknowledges his possible biases and tries to manage them to the best of his ability. The research findings were analyzed the theoretical framework in mind and comparison to the researcher's own prior perceptions was avoided.

As this thesis is focused on a phenomenon that is new and popular in business literature, the case organizations may want to present themselves as more advanced in the field of big data analytics than they are. In addition, the interviewees may overstate their own capabilities and skills in accounting systems, data analytics, or management in general. These issues influencing the study's validity and reliability cannot be eliminated but can be minimized. First, the research process and objective were explained to the case company clearly to avoid subsequent misunderstandings. The interviewees were provided anonymity, which let them speak more freely about cooperation with their managers and challenges in organizational practices. This is also the reason why the units in which the interviewees work are not disclosed. Both positive and negative experiences relating to the use of big data and their own role were asked to avoid a one-sided perspective on the phenomenon. The thesis draft was also presented to them before publication to let the interviewees check that their words have not been misinterpreted or confidential information leaked.

3.3. GENERALIZABILITY AND MOBILIZATION OF THE RESEARCH METHOD

The study sample consists of one case company. For statistical generalization purposes, the sample size is too small. However, statistical generalization is not the aim in case studies. Smaller samples allow in-depth focus on the studied phenomenon in the case organizations (Ahrens & Dent, 1998). Deep examination of one or few case companies enables a more holistic understanding of social structures and thus offers theoretical value (Vaivio, 2008). According to Lukka and Kasanen (1995), accounting research literature has a narrow view of generalization. The value of case studies has been underestimated because of the misconception that they cannot be generalized in any way. Case studies can be generalized by validating existing theories and building upon them. Even without statistical

generalizability, the research findings can be transferred to another setting. The researcher should understand and communicate the real business context and uncover deep structural relationships. Contextual generalization in case studies requires linking relevant history, institutions and markets to the argumentation of the study. (Lukka & Kasanen, 1995)

A single case study allows examination of a phenomenon in its detailed context. Understanding the organizational processes and competing interests reflected in management accounting practices allows a contextually rich explanation of the phenomenon that has theoretical value. Diving equally deep into the social dynamics of case organizations is usually not possible in multiple case studies. (Vaivio, 2008)

A typical challenge in qualitative field research of a small number of organizations is to match the research findings with the theoretical framework (Ahrens & Chapman, 2006; Vaivio, 2008). This problem may arise from constructing a wide theoretical foundation for the study that lacks a clear storyline (Vaivio, 2008). Inefficient use of time in the field interviews can also result in large volumes of irrelevant data from the theoretical point of view. These issues were managed in this study by aiming to construct a theoretical framework that is focused and has clear objectives. Before entering the field, the researcher had a thorough understanding of theory and the most significant interview questions had been developed based on the theoretical background.

The case study process started by contacting finance managers in the organization and requesting for multiple interviews on the topic of controller's role and data analytics. After receiving permission, the interview schedule was arranged with the participants so that the theoretical framework of the study was clear, and the first version of the literature review was finished before the interviews. The interview schedule was planned to ensure there was sufficient time in between the interviews for each one to be transcribed and reflected upon. Later, additional questions were presented via e-mail to supplement the empirical evidence gathered from the interviews.

The case organization was chosen for multiple reasons. First, the corporation has publicly acknowledged and discussed the phenomenon of big data and its significance for their business. As the entire S-Group has revenues over EUR 11 billion, it has resources to invest

and experiment in advanced analytics and big data applications. Furthermore, the organization granted a wide access to interview accounting professionals in the relevant businesses where external data is used. The possibility to interview data analysts also helped gaining a deeper understanding of data analytics and its use in the organization. They also provided a valuable outside view to the role of controllers in the organization.

The field study was conducted as semi-structured case interviews. A significant benefit of case studies is the researcher's ability to act reactively in the interviews. The point of using semi-structured interviews was to be able to guide the interview to the desired direction from the theoretical perspective and focus on the most relevant topics. In addition, this way the interviewees could not plan all their answers beforehand. For the reliability of the findings, interview questions were planned strictly relying on prior theory, and leading the interviewees towards premeditated answers was avoided.

Management accountants were asked different questions compared to data analysts (see Appendix 2). The role of controllers was emphasized as a topic in management accountants' interviews and big data utilization with data experts. The reason for interviewing data analysts was to have a more thorough understanding of data analytics used in the organization. To answer all the relevant research questions, it was also important to investigate data analysts' view on the possible marginalization of the controller profession and their own abilities to perform controllers' tasks.

All the interviews were recorded, which enabled the researcher to pay more attention to the responses and guiding the interview instead of writing the answers down. Furthermore, transcribing from a recorder is a more accurate and reliable method compared to using the researcher's own notes. All interviews were conducted in Finnish, so the interview quotes in the thesis have been translated by the researcher, which could lead to errors. To avoid this, before publication of the thesis, the interviewees had a chance to ensure that the quotes were accurate.

4. CASE SOK CORPORATION

4.1. CASE INTRODUCTION

SOK (Suomen Osuuskauppojen Keskuskunta) is a Finnish cooperative that operates as the central organization for the cooperative enterprises and other organizations in the S Group. It was established in 1904 to provide guidance and manage acquisitions of S Group cooperatives. Today, it offers procurement, expert and support services to the group and is responsible for its strategic development. SOK manages S Group's resources and monitors the operations of its various segments. At the end of 2016, SOK Corporation had revenues of 7 074 million euros and employed 6722 people of whom 1355 were employed by SOK and 5367 by its subsidiaries.

S Group is a network of companies operating in the retail and service sectors that has over 1600 outlets in Finland. It consists of 20 regional cooperatives and the SOK Corporation. The cooperatives throughout Finland conduct business independently and are owned by their members. In addition to its regional and national subsidiaries, SOK also engages in supermarket trade and travel and hospitality business in the Baltic countries and Russia. Supermarket trade, department and specialty stores, service station store and fuel sales, hardware trade and the travel and hospitality business are the group's key businesses. Furthermore, the S-Bank offers banking services to members and individual cooperatives operating in automotive and agricultural trade. S Group's purpose is to provide co-op members with competitive services and benefits profitably (see Figure 3).

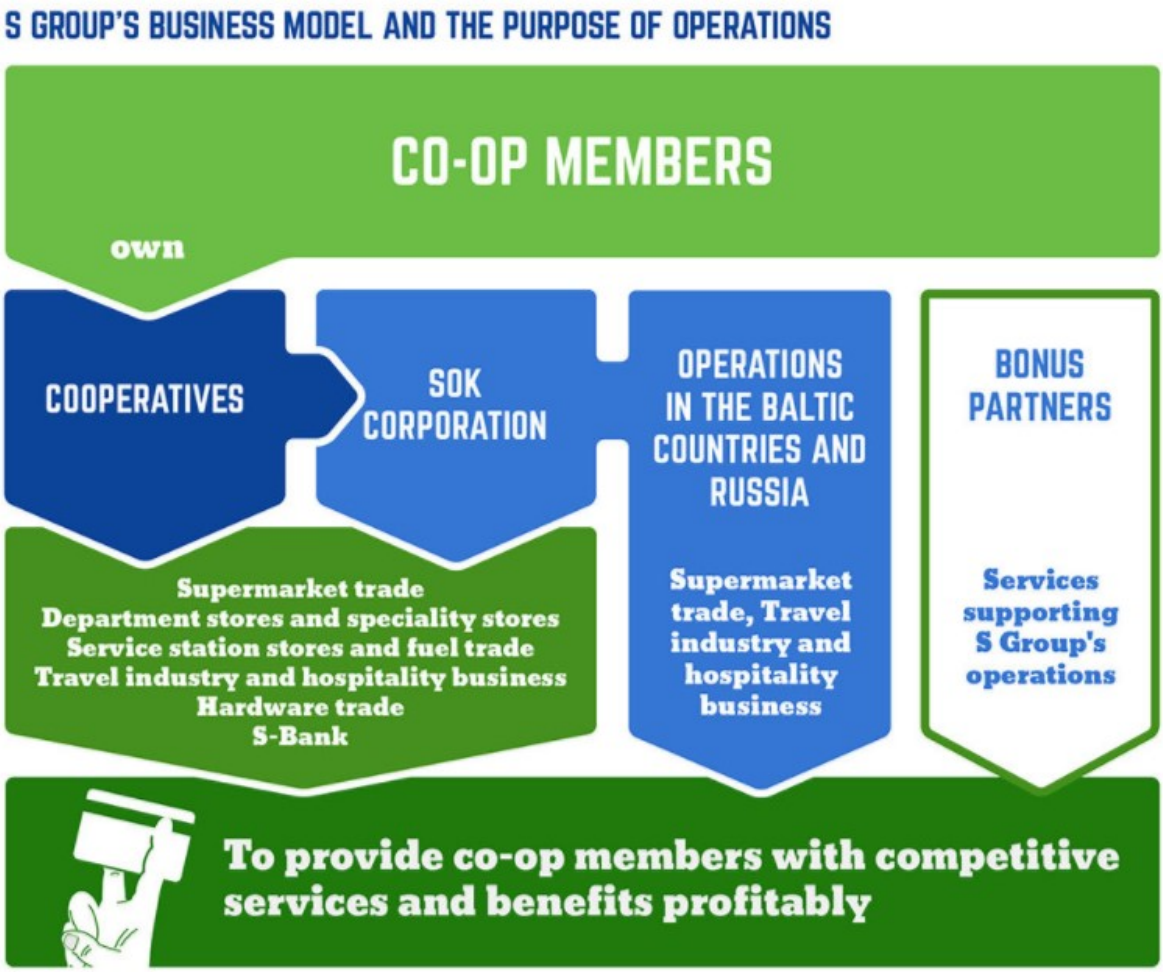

Figure 3: S Group's business model and the purpose of operations (S-kanava, 2017)

Among other services, SOK provides S Group businesses with financial support through a centralized accounting function, which offers financial reporting, tax, and business controlling services. Management accounting support is given to the entities depending on their organizational structure. When needed, business controllers may be dedicated to a single enterprise and thus work in a decentralized position focusing on one business. There are also controllers working for multiple entities simultaneously.

In addition to the centralized accounting function, SOK has chain management units that focus on supporting a particular industry. They are responsible for the development of business area value chains and their strategic guidance. For instance, the travel and hospitality industry chain management unit provides services and support to various hotel and restaurant chain leaders around Finland. This support includes management accounting and data analytics services by business controllers and data analysts.

The empirical evidence of this study focuses on the work and role of controllers working in SOK Corporation, either in the centralized accounting function or the industry chain management units. Their basic function and purpose is similar: to support the S Group businesses with management accounting services.

4.2. CONTROLLER'S ROLE IN THE ORGANIZATION

4.2.1. Controller's role and tasks in the organization

Controller's most important task in the case organization is to support the cooperatives' management decision making from the financial perspective. The role is dependent on whether the controller works in the centralized finance function or in an industry chain management unit. Controllers in centralized accounting services may serve multiple cooperative enterprises simultaneously or assist the group CFO. Chain management controllers focus on supporting managers of S Group companies in their industry and developing the chain management unit itself. Controllers may be transferred to different units according to the needs of different businesses. Most controllers have served multiple units during their careers.

> *"Basically, some of the bigger entities have their own business controllers that work for them 100%, otherwise the centralized accounting function is used." (Controller 1)*

> *"Controllers are often 'rented' to different units, especially from centralized finance. Thus, they may have tasks from previous roles to take care of as well." (Controller 3)*

Budgeting, financial forecasting, capital budgeting and management reporting are the most common controller tasks. Approximately half of the working time is spent on routine reporting tasks compared to independent analysis. The latter includes searching for causal connections and finding trends in the unit's financial figures. Reporting to group finance is a significant portion of the monthly workload, especially for decentralized unit controllers. In addition, controllers are often involved in various accounting system development projects throughout the year that may require their full attention and worktime.

> *"At worst, the routine stuff can be up to 60-70%, so at times there is very little time for development and independent analysis." (Controller 1)*

Monthly reporting tasks have increased as the organization began implementing rolling budgeting practices about two years ago. Controllers in the centralized accounting services

must spend time coordinating the monthly rolling budgeting procedure in all entities and decentralized controllers in different businesses need to make sure that the figures are communicated in time. This reduces time for non-routine analysis work. There are differing opinions whether rolling budgets have been worth the time.

> *"I am not convinced that we are benefiting from fast-paced budgeting yet. Sometimes it feels like the numbers are updated monthly just for the sake of it." (Controller 2)*

Controller's role within the organization varies considerably. Most consider themselves as business partners to their managers whereas some lean towards being providers of financial reports. Deeper analysis of financials is welcomed but time spent on routine reporting tasks hinders the role change. Information system and other development projects may remove the controller from the business partner role occasionally for months.

> *"There are managers who see business controllers as sparring partners but also those who consider us to be bookkeepers. Unfortunately." (Controller 5)*

> *"At the moment, I work more as a 'report machine' to be honest. I calculate things and communicate the results forward. I help the people in the management team make their decisions." (Controller 3)*

In industry chain management, reporting financial results is often handled by data analysts. They also take care of a significant portion of financial analysis and help controllers analyze data that is in less structured form. Controllers are more focused on budgeting, cost control and participating in management team decision making. Thus, analysts work more with the raw data and controllers' role is to communicate it forward.

> *"Controllers do budgeting, compile material and 'sit on the money', so to say. We often dig the data and bring it to them to be presented in the management team." (Data analyst 1)*

The main contribution of controllers is thought to be translating operational changes to financial figures. Controllers are expected to be able to estimate the monetary impact of operational decisions. In addition to the short- and long-term impact, controllers must be able to produce accurate information on the mechanics of a change. Managers want to understand the financial impact on a detailed level, for instance, which costs have risen and what the future risks are.

> *"We have to tell them what the result consists of, and what can be done about it. From the perspective of transparency, it is important to give them the detailed information, what causes what and where the numbers come from." (Controller 1)*

In addition to manager preferences, controllers' individual capabilities and the business the controller is working for are the main factors influencing their role formation. Some units' structure requires more of a coordinator or watchdog role whereas in other units more time is left for proactive analysis work. Controller's personal attitude and willingness to develop as a controller also makes a difference over time. If the controller has gained experience and understanding of the business behind the numbers, a business partner role to the manager is more likely.

> *"It really depends on the manager, yourself and what unit you work in." (Controller 2)*

> *"Personality, skills, experience and personal interests all have an impact. In some positions you must have the right characteristics so that you get along with people. You should really say it out loud if you want to do something different or make a change." (Controller 6)*

Tasks provided by the manager are the top priority for controllers. Thus, manager's expectations play a role in determining controller's work content. However, controllers' own skills and interests influence which tasks managers assign to them. If the controller wants to get more involved in a certain project or field of work, it is usually possible. Managers are thought to be open for new ideas from controllers and discussion regarding work content is encouraged.

> *"You can definitely go and suggest things if you have an idea or are interested in something new." (Controller 2)*

> *"Our cooperation is quite informal. We throw ideas back and forth, spar each other and try to look at issues from different perspectives." (Controller 5)*

Business orientation is considered a significant advantage in controller's work. Controllers see that working as a business partner with the manager would not be possible without basic knowledge of business drivers, sold products and customers. Operational issues are usually tied to financials, and controllers are expected to understand both. Discussing issues with other management team members only from the financial point of view would not be prolific, especially as others may have a limited understanding of accounting measures.

> *"Knowing the business helps you understand the numbers as well. You shouldn't be blindfolded in that sense." (Controller 2)*

> *"You may end up in a situation where you are not doing traditional accounting, for instance operational issues are sometimes on our table. You can and should learn from those." (Controller 1*

4.2.2. Controller's role in strategic decision making

Controllers are involved in strategic decisions usually through unit managers. The agenda of the unit manager often dictates which decisions the controller is involved with at a particular time. These decisions include large investments, market entries, pricing decisions and goal setting. In the centralized finance function, controllers support multiple managers from different entities and occasionally assist the corporate CFO with his decisions.

> *"The best operating model in different business cases, capital budgeting decisions, simulations for different scenarios. For instance, if we move an outlet to a new building, what are the costs. In cost calculations, controllers always have a significant role." (Controller 1)*

> *"We are actually quite close to the CFO, it is easy to go talk to him and present ideas. He also asks us to investigate various issues quite often, so we do have a dialogue going on." (Controller 1)*

The role in strategic decisions depends greatly on whether the controller is part of a unit management team. If not, the controller's role may be limited to being a provider of needed material to management team members. This may contain forecasting revenues or calculating long-term costs of a new outlet. If the controller has a suggestion or wants an issue discussed, he or she can ask a person in the management team about it. However, the message is less likely to be delivered as the middleman may not be familiar with the issue or consider it as important as the controller does.

> *"All business controllers are not in management teams, but if you are, you can really influence in a different way." (Controller 1)*

> *"There is definitely less power to influence in that case [not being part of a management team] as hierarchy comes in the middle. If the controller is in the management team, there is feedback in both directions and better understanding of causation effects. Opinions can be voiced in a much better way." (Controller 3)*

If the controller is in the unit's management team, he or she is considered to have an equal role in strategic decision making compared to other management team members, with the exception of the unit manager. Scale of input on decisions is dependent on the subject at hand and whether the management team member has experience on it. Financial considerations, such as profitability and risk calculations, are usually controller's expertise. On other issues that controllers may not be familiar with, they have little or no direct input

on the decision-making process. Examples of these could be product development, marketing strategies or customer satisfaction improvement.

> *"As a controller, you can really influence by being active and taking a lead in a project if you have a good idea and have prepared it well." (Controller 2)*

> *"All decisions are collectively decided in the management team and as a part of it, the controller can voice his or her opinion, but the manager makes the final call as he is the one to bring the proposal to the next level of hierarchy." (Controller 4)*

From the controller's point of view, it is difficult to determine whether a decision is strategic or not. A new IT project or organizational change may require contribution from controllers so participating in planning or implementing strategic decisions appears randomly and is unpredictable. Financially large investments are complex and bureaucratic processes that involve multiple levels of hierarchy and may require approval from top management or the executive board. Organizational politics play a role as those giving a suggestion aim to lobby its advantages and others try to analyze the situation as objectively as they can. Financial figures are the basis for all decisions, but powerful individuals may get their will through even if the numbers are not so favorable.

> *"There are some strong persons and personalities here that may sometimes drive their agenda and get it through but usually we decide according to the numbers." (Controller 3)*

> *"Anybody can make an investment proposal look good in an excel spreadsheet; just raise the revenues and cut the costs a little. We have to be able to see when it's nonsense." (Controller 4)*

In some cases, the controller plays a large role in helping the manager form a picture of the current situation before making a decision. This may include communicating current revenue projections and cost development in relation to the budgeted numbers. The controller is expected to provide reasons for abnormalities and changes. In some cases, scenario analysis skills are useful. Other management team members may not have the accounting knowledge to understand how an investment affects financial key performance indicators. Controllers should be able to understand and communicate the expected consequences of actions in a way that is understandable also to people without an accounting background. Although it still happens, forwarding the financial figures without any analysis is not considered adequate.

> *"Our job is to support management decision making in the entities, tell them what the current financial situation is and where they are going, what the bottom line consists of and what can be done*

about it. It's about giving a more detailed view and explanations for important figures." (Controller 1)

"I've told people that those managers in the 'field' understand numbers, there is no need to write that revenues have risen 15%. Unfortunately, we still see business controllers that just turn numbers into words." (Data analyst 3)

In large investment decision-making processes, controllers may have essentially two roles. First, they must ensure the planned investment complies with corporate policies. Others involved in the project may not be aware of these policies, thus the controller is in a unique position. On the other hand, the controller supports the unit manager as a management team member and provides opinions based on financial calculations. Decisions must have financial justification, so the controller's background work and views are valued.

"You have two roles; support decision making but also be sort of an auditor and look at it from corporate policy point of view. I think our perspective is really valued." (Controller 1)

Attributes that were thought to differentiate strategic decisions from operational ones were a long planning process and a long-term impact. This increases the complexity of the decision-making process and makes it more difficult for controllers to point out when the actual decision is made. Both planning and implementing a decision may take months and require work both before and after action is taken. Furthermore, decisions are always based on estimations of the future, which can be very uncertain. Therefore, controllers thought that their help especially in predicting future consequences of decisions is highly valued by managers and other colleagues.

"If a decision is difficult or complex and has long-term consequences, different opinions are usually heard. Especially in these situations, the controller may have a significant role and his or her opinions may have a large impact." (Controller 4)

After a strategic decision, such as a large investment, the controller's task is often to monitor and communicate the consequences of the decision. Measuring and communicating consequences of previous decisions is crucial because it enables learning and often influences the assessment of future decision alternatives. First, it must be ensured that following the implementation progress is possible. Coordination of key employees is often the controller's responsibility. Second, information systems should be able to provide the needed data to see whether goals have been achieved. If changes to the initial decision should be made, the controller needs raise the issue in the management meeting.

"You really need to get into the numbers and be able to communicate clearly what they mean and how they affect the success of a project. Our job is to ensure the progress is followed closely." (Controller 1)

Controllers in the centralized finance function have a slightly different role compared to unit controllers also in strategic decisions. They may receive requests from different businesses to collect certain financial data or to analyze the cost savings of an investment. In that role, discussions with managers are less thorough and the role is typically limited to searching and communicating a piece of information. On the other hand, controllers in different chain management units may feel like decisions are made somewhere else in the organization. There are situations, where it can be difficult to understand why particular decisions have been made on the group level.

"Sometimes you just have to accept that a decision has been made somewhere up the hierarchy and move forward." (Controller 3)

Supporting a unit manager and participating in strategic decisions require understanding of the external business environment. Management team discussions concern various stakeholders also outside the organization, such as suppliers, customers or competitors. It is not explicitly stated by managers, but controllers are expected develop an understanding of the market that the unit is competing in. For instance, in addition to calculating profit margins or costs, the controller should be aware of how these numbers compare with industry peers. Whether this is the case varies greatly between controllers.

"One can say it is a requirement to know how we are doing compared to others. I think managers expect that as well. As a business, you can't be too focused on yourself." (Controller 2)

In addition to external orientation, the need for future orientation is emphasized. The time period for forecasting is longer and is started earlier in the year. This is partly due to the rolling budgeting process, but managers also expect more insight about future trends in decision making. Strategic decisions have far-reaching consequences that controllers should be able to evaluate. They are expected to have an opinion about crucial financial figures such as cost structure development and revenue streams over a longer period time. However, data analysts in various units may have these same responsibilities and can often provide more accurate analysis compared to the centralized finance function.

"You could say that looking into the future is really a theme now. For instance, next year is already worked on during early spring, which was not the case before." (Controller 2)

"They [centralized finance] still lag behind. We can get a lot of the numbers from our system before the finance function gives them to us." (Data analyst 3).

Unit managers and controllers usually communicate on a daily basis. Their cooperation is informal and described as mutually supportive. Controllers feel their suggestions and ideas are welcomed. However, the manager is clearly in a leading position in the management team and has the final decision-making power. Controllers 'spar' managers' strategic decisions from the financial point of view but further questioning the manager's decisions could be considered difficult or inappropriate.

"Often the controller gets paid by the unit manager, so it may be a little difficult to question his or her decisions a lot. On the other hand, sparring in the form of informing about downsides of a decision is definitely ok." (Controller 1)

The interviewed controllers found that diversity in management teams and elsewhere in the organization has a positive impact on the decision-making process. Perspectives that the controller may not have thought of are brought up by individuals from different backgrounds. For instance, having representatives from sales, IT and finance functions in the same room may improve the implementation process and ensure that the required action is carried out from each function. On the other hand, it increases the importance of controller's communication skills. Controllers thought that it helps their cause if a group of decision-makers includes financially oriented people that understand the controller's perspective.

"It is great if there are people from different backgrounds with different perspectives and skills. I feel like a lot of people have financial knowledge but it's still up to you to make your case." (Controller 1)

4.3. IMPACT OF BIG DATA ON CONTROLLER'S ROLE

4.3.1. Use of big data in the case organization

The S Group has over 1600 outlets in Finland, most of them being retail grocery stores, gas stations, restaurants and hotels. This results in millions of customer transactions daily and an increasing volume, variety and velocity of data. For over a decade, the group has aimed to collect and analyze this data to extract valuable knowledge and financial value from it.

However, in the last years, there has been an increased emphasis on the use of data in capital budgeting, direct marketing and logistics.

> *"Customer analytics for marketing, product selection, investment analytics and analytics related to logistics are the significant ones to us." (Controller 1)*

Particularly in retail, the large volume of data is a consequence of the enormous unit sales numbers. In addition to measuring overall sold products, bonus card purchases collect information on product level. This means that a sold product can be connected to a particular customer. To encourage using the card, the customer receives a bonus based on monthly purchases. A similar concept is used in the travel and hospitality business, where a bonus card collects information about customer transactions in S Group hotels and restaurants.

> *"The amount of data is endless, and the information flow will surely not decrease." (Data analyst 1)*

The bonus card is used for customer retention and to collect information for developing direct marketing and new digital products. Marketing could be in the form of newsletters or direct digital communication through a mobile application or e-mail. Examples of new digital services to customers are electronic receipts sent to customers and mobile fueling, in which gas can be purchased through a mobile application. The goal of collected customer data and analytics is to understand customer behavior more comprehensively. Information can also be made available to customers based on their needs. For instance, customers can monitor their own purchase history or check their bonus accruals.

> *"As a result of digitalization, the importance of marketing is increasing. For instance, it makes no sense to send me cat litter product ads if I don't have a cat." (Data analyst 3)*

As stated in their strategy, developing customized services to customers is a significant part of SOK's business. Project teams in different parts of the organization are constantly working on new ideas that would bring value to the customer and differentiate from competitors. Although direct marketing is more often discussed in media, developing digital services is considered the more important business driver for the organization. To develop new services, understanding the customer is a key factor. Thus, leveraging big data plays a crucial role in designing and implementing these services.

> *"The purpose of S Group's operations is to provide co-op members with competitive services and benefits in a profitable manner." (S Group strategy, 2017)*

Almost all interviewees considered customer bonus card data to be big data. However, the corporation receives large volumes of data from various other sources in many formats. Most of them relate to understanding industry-specific purchasing behavior. For instance, the organization conducts constant customer satisfaction research in its restaurants and hotels. Tens of thousands of satisfaction surveys are received yearly and registered to the database. In addition, the company employs people who visit restaurants to check if the outlet is following the concept designed for them. This creates a huge amount of information that can be combined with monetary values when analyzing performance.

> *"We really have invested a lot in this. Even our market research partner company Taloustutkimus says we are pioneers in studying customer behavior." (Data analyst 3)*

In addition to customer satisfaction and purchase behavior, data collected from product distribution creates new opportunities for optimizing the logistical process, which is one of the most important factors affecting the profitability of a retail business. SOK has new logistics centers in Sipoo that are largely automated. With a barcode in each item, the location of goods can be closely monitored and measured for improved efficiency. Pricing, safety labels and special packaging are now performed at the logistics center before dispatch to a retail outlet. This has an impact on distribution costs and availability of products to customers. With thousands of items, the optimization of the distribution network is an extremely complex calculation. The establishment of new logistics centers has made more detailed data available about the movement and storage of products. Organizing this data and using it to improve efficiency of the new center is a work in progress.

> *"It is important to know how much goods we have, where they are and so on. For my work this is a lot more important than bonus card data." (Controller 3)*

The term big data seems to be familiar to both business controllers and data analysts. It is acknowledged that the amount and variety of collected data has grown significantly in the last 10 years. However, a large amount sales data, for instance, has been available for decades. The most significant development has been made in making data accessible in a structured format and finding ways to utilize it.

"We do acknowledge that we have a data source system that generates an incomprehensible amount of data. 6-7 years earlier we didn't really know how to use it all, so we have progressed, especially in making it easier to digest." (Data analyst 1)

Organizing data collection and storage has been a long project that has required a significant amount of resources in recent years. The main goal has been to harmonize the data and compile it so that the user does not need multiple systems for analysis. SOK has a common database that is managed by a separate support unit and available to the entire organization. However, business areas have different information systems suited for their individual purposes. For instance, retail has a different system for data analytics than the travel and hospitality business. The platforms are slightly different, but the information analyzed is largely similar.

"The main thing has been to get it all to the same platform. However, it has taken several years and millions of euros. So, it doesn't happen just like that." (Data analyst 1)

"We have slightly different systems between retail and travel business, but the same things can be looked at and analyzed. So, we cannot say all the information is in the same place." (Data analyst 1)

Integration of data storages and improving data's usability is a continuous process for the organization. Sales data from outlets, budgets from the budgeting system, working hours and customer satisfaction survey results are all combined into a single information system where they can be compared and analyzed. Especially sales data plays a large role in analyzing the performance of an outlet, improving its selection and marketing. Most important aspects of sales data include average purchase value, amount sales transactions, sales timing of different products and comparisons of product category sales. The sales are also compared to labor force in the outlet, as it is one of main costs, especially in restaurants and hotels.

"The most use for us is probably the sales data; what is the average purchase value, what products are sold at which time of the day, who has worked at those times, do we have the right personnel in place at the right time, for example in hotels." (Data analyst 1)

The possibility to combine and compare data from different outlets is already used in decision making. For instance, establishing a hotel can increase revenues of cooperative retail stores and restaurants in the region. The impact of these decisions can be simulated using data from other outlets. Assessing the consequences of major investments require cooperation between data analysts and management of the entity planning the investment. Data analysts in different industry chain management units are constantly trying to innovate

ways of combining the data from different sources to contribute to data-driven decision making.

> *"For instance, if we want a new store, there is a service which shows the influence of the decision on the area's other outlets, both negative and positive." (Data analyst 2)*

> *"The algorithm takes into consideration the number of restaurants in the area as well as visitors from other places staying in hotels, which have a major impact on the potential sales of new outlets." (Data analyst 3)*

There are several challenges in extracting valuable insight from various data sources. As S Group is a network of companies operating around Finland in different retail and service sectors, harmonizing the collected data and integrating it to a single system is difficult. Major synergy benefits can be realized only after the information is in comparable format and understandable to employees outside the entity from which the data is received.

> *"It requires experience and training. There is a lot of data, it is not 'clean' and it is received from different business locations in different formats. There are a lot of things you have to know about the data as an analyst, so it really requires training." (Data analyst 2)*

Occasionally, information system malfunctions cause issues that may negatively impact the data collection and utilization process. Such malfunctions often originate from external service providers so there is little that can be done about them in the short term. Automation in data analytics could also be further improved as data analysts are still forced to do plenty of manual analysis work.

> *"System problems are usually associated with the service providers so as analysts, we cannot really do much about it." (Data analyst 1)*

> *"We still largely have to interpret, calculate and analyze a lot ourselves. But the system can do some easier tasks, such as give an alarm if sales drop drastically et cetera." (Data analyst 1)*

Leveraging big data may require support from experienced data specialists. To interpret and analyze the data in decision making, there is often a need to have a specialist in between the raw data and the business decision maker. For instance, there is a team of analysts dedicated to managing bonus card data. The cooperatives should be able to use the data more independently as a self-service, but in reality, many issues need to be manually investigated by data analysts.

> *"With these amounts of data, those 'self-services' are sometimes difficult to use and it requires a person in the 'frontline' that is interested and has time to develop the system with us." (Data analyst 2)*

Data privacy laws set limits to collecting information about customer behavior. Significant resources are also directed towards information system protection to ensure data security. The organization must internally control the accessibility of customer data and employees working with the data need to be aware of the regulations. Violating data privacy laws could result in significant fines and negatively impact the group's reputation. Currently, the customer is given the chance to decide whether his or her purchase data is collected and used for marketing and service development purposes.

4.3.2. Impact of big data on controller's role in strategic decision making

Controller's Role in Utilizing Big Data in Strategic Decision Making

Supply chain optimization, service product development and direct marketing are examples of organizational functions that can benefit from big data. Business strategies, capital budgeting and organizational targets are also increasingly based on quantifiable data collected from outlets. However, big data has not revolutionized strategic decision making. From the perspective of management accounting, traditional financial figures from the budgeting system and cost control in capital budgeting are still the basis for long-term decisions.

The scale of impact of new data sources on controllers is highly dependent on the organizational position of the controller. Centralized accounting service controllers rarely encounter big data or use advanced analytics to leverage new information sources. On the other hand, decentralized unit controllers may be involved in decisions about developing new data applications and utilizing data in decision making. To finance directors and executives, big data may help in deciding between overall strategic directions of businesses whereas lower level business controllers work on leveraging it in operational issues.

> *"Supporting management decision making is the most important [task], and analytics is definitely a big part of it." (Controller 1)*

Controllers do not use big data in their everyday work. Traditional management accounting tasks are not utilizing new data sources. Consequently, the impact of big data on controllers is limited. For instance, budgeting and most investment calculations are done using prior periods' financial figures. However, controllers working in a decentralized position in

different entities or in industry chain management units may be affected by big data if their businesses are benefitting from external data from new sources. In these cases, they may be using newly available data for various business case analysis or work on a system development project to leverage big data.

There is a systematic effort to make more data-driven investment decisions in the organization. For instance, before establishing a new restaurant, the expected sales volumes and purchase values per customer are compared with historical data from other comparable outlets. Similar calculations are made for labor and equipment costs. Employees supporting decision making, such as controllers, need to be aware of this notion when sparring managers. Controllers can utilize these new tools and question a decision if its expected profitability is not based on numerical evidence.

> *"It is actually in our strategy to make 'higher quality' investments. For example, you can easily see if someone is expecting unrealistic average receipt values or sales numbers." (Data analyst 3)*

Controllers with experience of information systems are more likely to be involved in development projects that leverage new data solutions. In addition to technical and customer specialists, it is considered important to have financial perspective when designing new services to customers. Depending on the skillset of other professionals in the team, controllers are sometimes participating in these projects. As others are often focused on the product itself, controllers can help estimate the revenues and costs of the investment.

> *"A team is established for larger development projects where the most suitable persons are chosen from both IT and finance." (Controller 2)*

> *"There are controllers with the financial perspective also involved in these in these projects, for instance developing new services to customers." (Controller 3)*

Growth of data volumes is one of the motives for increased automation. From controller's point of view, the most significant development has been made in accounting information systems. Slightly less manual work is now required for internal financial reporting. In some cases, basic financial reports are automatically produced for anyone to access. In addition, information systems are more user-friendly and searching for information is faster. Thus, a controller has more time for independent analysis, which is a prerequisite for participating

in strategic decision making. However, in some cases, the requirements for internal reporting have increased.

> *"You get the information you need faster and there is more time for the actual analysis. On the other hand, reporting still takes a lot of my time so it has not made a huge difference." (Controller 2)*

Controllers find it beneficial that the data collected from customer interactions is widely available in the organization. For instance, detailed sales data and customer satisfaction surveys in restaurants and hotels are not restricted just for analysts. Controllers can access the data and use it for analysis without the need to request someone else for it. It creates the opportunity for controllers to leverage it in decision making. Whether the data is actually used or not depends on the business case and proactiveness of the controller. Most controllers are occupied with their routine reporting duties and do not utilize customer databases, for instance.

> *"It is definitely good that the data is available for controllers, that is the first step to utilize it. There are all kinds of information, but in this role, I don't really use it." (Controller 3)*

Controllers' unit's structure determines to a large extent how new sources of data and business analytics influence their role. For instance, if a controller is not in the unit's management team, his or her duties focus more on monitoring costs of investments and producing reports for management team members to analyze. In this case, the controller may learn new technical skills because of new analytics tools but the role in decision making is not influenced by the fact that the data used for analysis comes from new sources. In general, consumer businesses with high sales volumes produce more data. These business areas have invested in technologies, tools and human skills to leverage it. Consequently, controllers in these units are involved in decision making situations where external data is leveraged, and a more data-driven approach is suitable.

Controllers' individual work experience and skillset also plays a large role in determining big data's impact on their role. Many controllers have worked their whole careers in traditional accounting tasks such as budgeting, cost management and financial reporting. Such controllers are often not expected to dwell deep into opportunities brought by big data as there are others, more experienced data specialists available. For instance, controllers' role in investment decisions may be limited to calculating costs of acquiring a new technology, or ensuring that an investment complies with corporate policies.

On the other hand, controllers with experience in data analytics or information system development may have a significant role in leveraging big data in a particular unit. They may realize opportunities provided by collected data that others do not. The ability to find valuable information and interpret unstructured data may lead to increased influence in strategic decision making, which applies to data analysts as well as controllers. This could be observable as management team members would request analysis more often and the final decisions would follow the recommendations of the controller.

> *"If you can come up with new ideas about how to leverage data, it is definitely valued and welcomed higher in the organizational hierarchy." (Controller 2)*

> *"I received a lot of questions about investments because I knew how to simulate. Usually the decision made was in line with the analysis I produced." (Controller 3)*

Because of big data and new technologies, more real-time data is collected by the organization. Information about movement of goods and customer behavior is more extensive and up-to-date. Managers require more information about emerging trends rather than historical figures. Overall, reporting and decision making has gradually become future-oriented and availability of big data could be contributing to this trend. Being able to collect new non-monetary data has led to discussions about increasingly utilizing new data for financial figures as well.

> *"We can already get 'enriched' financial reports that include customer satisfaction and other non-monetary variables." (Controller 2)*

> *"In our forecasting system there is a chart of accounts where we see what it might look like five years from now. Considering the future is encouraged and new data could definitely help in this." (Controller 2)*

Furthermore, large scale investment decisions require more accurate forecasting and analysis of future cost development. Controllers have more influence on decisions if they are able produce justified data-driven predictions. Simulation skills are useful in controller's work. However, external data is still rarely used in financial forecasting although its potential is acknowledged. At the moment, most simulation is done based on prior financial figures, but data from new sources could be used in the future.

> *"Forecasting is monthly nowadays, which was not the case before. We accept that it is not 100% accurate but close enough." (Controller 1)*

"Yes, that is the direction, we are going more towards predicting the future. Budgets are just a situation update, and allows monthly predictions." (Controller 1)

Controllers have played a large role in planning and implementing new rolling budgeting processes. However, leveraging big data in budgeting has not been considered. More complex simulation techniques using various data sources are used predominantly in capital budgeting. Significant changes in budgeting are not believed to happen anytime soon. In addition to large costs, it would require clear vision and evidence that investing in redesigning the process would be profitable and not cause chaos.

"*More complex simulation is mainly used in investment calculations. Perhaps in budgeting there could be use for it [simulation], but you shouldn't complicate things just for the sake of it. Simulation is complex and often times it is better to think simple." (Controller 3)*

The necessity of extensive monthly reporting is questioned as it reduces the amount of time left for independent analysis work. This is also linked to the controller's role in decision making. The more time controller must spend on reporting, the less time he or she has for pondering implications of large-scale strategic decisions, including investments in big data analytics.

"Reporting last month's figures is more 'nice to know' material rather than anything groundbreaking for decision making." (Controller 2)

"There should be more time left for thinking about the external environment, but you cannot do everything yourself." (Controller 1)

Controllers do not seem to have a clear idea of how new information sources could be utilized in budgeting and financial reporting. There is still a lot of room for improvement in traditional monthly reporting and that takes a large portion of their work. Planning a whole new budgeting process such as beyond budgeting is not considered to be for the controller to decide, although suggestions are welcomed. If major changes would take place, controllers would expect them to come from someone higher in organizational hierarchy or with more information system knowledge. On the other hand, data analysts had clear suggestions on how budgeting could be improved.

"I guess it would require vision and knowledge on what the potential uses could be." (Controller 2)

"One simple way to improve budgeting would be to determine sales budgets based on average purchase value per receipt and number of receipts. That would be more relevant from the perspective

of everyday business because we could see whether the differences come from volume or value." (Data analyst 3)

Controllers are not directly involved in the process of extracting valuable insight from customer data and improving the bonus card database. There is a separate team of data analysts working on the data received about customers from bonus cards. Furthermore, the marketing function is responsible for improving direct marketing. Thus, developing the data collection process and understanding customer behavior through newly available data is not on the agenda of most controllers.

"I don't work very close to the customer, so I don't really use or think about the customer data." (Controller 2)

However, in addition to customer data used for direct marketing and sales forecasting, huge data volumes from the distribution channel can be utilized in controller's work. In a business with large sales volumes, logistics are a significant part of the business's cost structure. A controller in the market trade chain management unit is working on a project to adjust pricing based on the available data from a new distribution center. With an understanding of working capital management, the controller has a role in making the information accessible for future decisions to optimize the delivery process. For instance, decisions about vendor or distributor choices can be made based on data of movement and storage of goods.

"I work on improving reporting, data quality, accessibility and monitoring of financial results versus logistics and logistics center costs." (Controller 3)

Data collected from retail outlets, restaurants and hotels is used to develop performance metrics for employees. Targets can be based on performance of other outlets in a similar market. However, store and hotel managers decide on them within limits of group policies. They are thought to have the most thorough knowledge of their outlets' cost structure and employees. Thus, the decision-makers are 'frontline' employees instead of controllers in the centralized finance unit. In some cases, data analysts and controllers may give support on incentives if asked but this is rare.

"The hotel and restaurant managers plan and develop incentive systems, they all have their own pay system." (Data analyst 1)

One of the identified obstacles for controller's larger role in strategic decision making was lack of business understanding. For leveraging big data, it was considered even more important than technical analytics skills or organizational position. Some controllers have only worked in traditional accounting tasks in the centralized finance function and been involved in projects to improve supporting accounting services. Thus, they may have a limited understanding of what is required for profitable business in the restaurants, hotels or other outlets. The needs of different key persons and business functions may be unclear to the controller, which can influence managers' willingness to involve controllers in decision making.

> *"It is not a question of technical skills. If you don't understand the business, the technical stuff is almost irrelevant. Some controllers have gone through the traditional accounting route through managing purchase ledgers and routine reporting to business controllers, in which case they may have no idea of the business itself. It would improve your professional know-how if you would work in the 'field'." (Data analyst 3)*

Although controllers may be involved in information system development, often the role is limited to implementation of decisions made higher in the organizational hierarchy. Controllers can suggest new methods to leverage data that is already available but decisions about what data to collect and how to collect it are done by group management and data analytics experts. The availability of big data has not changed the fact that most controllers are focused on their own unit's financial reporting and performance. To some extent, this limits the possibilities of controllers to use their creativity and leverage external data in different organizational functions.

> *"It is often the case that the plans are made elsewhere and brought here for finance to see." (Controller 1)*

The interviews indicated that the availability of new data has not resulted in an increased influence of controllers in strategic decision making. The impact of big data was not thought to be a radical technological change that would trigger controller's role for re-interpretation. Large volumes of data have been available to the company for years, even decades. Thus, controllers' perceptions of their own roles were not very different compared to five years earlier. Information system knowledge was thought to be more valued and forecasting future figures was viewed to be more important. The basic purpose of the role in controllers' view, such as being a sparring partner to the unit manager or coordinator of the budgeting process, has remained.

Cooperation with Other Professional Groups

Use of new data sources can increase an individual's influence in strategic decisions. However, this requires communication skills. Summarizing data, explaining calculation techniques and visualizing results are traits required from controllers as well as other professionals. In addition, unit managers and other management team members need to be assured of the credibility of the data used in decision-making situations. Assurance by external service providers is often not adequate.

> *"It is very important. You have to know how to visualize and summarize. Everyone receives so much information all the time that you have to communicate it in compact format to draw people's attention." (Data analyst 1)*

> *"Management's time is and will always be limited so summarizing and communicating information from large sets of data is the key for making an impact." (Controller 4)*

Controllers do not make strategic decisions by themselves. Cooperation with others is needed to make an impact in the organization. Controllers that are not in management teams discuss finance-related issues with someone in the management team and influence large-scale decision through them. Controllers in management teams must be able to convince other management team members to have an impact on decisions. Numerical evidence is needed to support opinions when sparring the unit manager, for instance. If big data is available, it can be used support the views of a controller. However, effective communication is needed both when gathering data with the help of others, and communicating it forward.

> *"You have to really get into the numbers, what they are based on, spar, and above all, be able to communicate to others what the implications are." (Controller 1)*

Teams of data analysts work in retail as well as travel and hospitality business. As new data is available and more easily accessible, there is an increased emphasis on data-driven decision making throughout the organization. Analysts' analysis is often used in decision making and their input can be seen in business area strategies. Compared to controllers, data experts have a more significant role in strategy formation. Many controllers work closely with them and are dependent on their expertise. Often, controllers or unit managers need an analyst to investigate an issue that they are working on. Thus, cooperation with data analysts is typically an important part of improving the controller's decision making.

"When we were formulating our strategy, analysts were in a very important role. I was involved in every step of the process. For instance, sensitivity analyses played a large role. We tried to determine what happens when this or that variable changes, what needs to happen to achieve this goal and assess the sensibility of our targets. You can say the strategy was built on data." (Data analyst 1)

"In some cases, business controllers are very close partners with analysts." (Controller 3)

There are numerous data analysts that have switched to business controllers. The interviewees expressed varying opinions on whether the two roles are different. Business knowledge is required for a large role in strategic decision making regardless of the organizational function. Currently, controllers have more responsibilities concerning budgeting and cost control. With basic knowledge of accounting and the business in question, an analyst can be well suited for business controlling. Furthermore, a business controller may benefit from a data analytics background when assessing proposed action alternatives and suggesting new ideas.

"Drawing the line depends so much on the task. The job is really not that different." (Controller 3)

"There is a difference. Business controller's perspective is narrower whereas a good data analyst also looks at other things besides accounting figures." (Data analyst 3)

"Surely there would be a lot of use for skills in data analytics. It would enable new ways to see things and interpret the trends and the future in general." (Controller 2)

Controller's understanding of the business was not considered to be superior to other professional groups, such as data specialists. In fact, controller's view of the whole business and different organizational functions was described as quite narrow by some interviewees. This was thought to be the result of tasks focusing on budgeting and costs of the particular unit the controller is working in. A controller that used to work as a data analyst thought seeing the 'big picture' was more important in the previous job. As a data analyst, new sources of information are considered much more often compared to controllers.

"I used to think about the world from a wider perspective and combine data from different places. The view is narrower now." (Controller 3)

Controllers are not, however, totally dependent on IT support and data analysts. Data integration and information system development towards user-friendliness are of increased importance as the organization has implemented new databases and managers aim for more data-driven decisions. Under these circumstances, controllers too have improved their abilities to search and extract valuable information from massive sets of data.

”I think the situation has forced finance people into information system know-how. I don’t think those people who use post-it cards instead of computers exist anymore.” (Controller 3)

Increasing dialogue between controllers and data analysts could benefit the organization in leveraging new information sources. In many cases, a data expert could investigate an issue that a controller is pondering. On the other hand, a data analyst may have an investment idea but is unsure if it is unrealistic from the financial point of view. Distance between the two groups may hinder both from more efficient process development and learning from each other.

“In some cases, it is already done hand to hand. It feels like we are too busy to do both jobs simultaneously, perhaps it would be possible in a smaller company.” (Data analyst 1)

Outlook for Controllers Leveraging Big Data in Strategic Decision Making

There was no indication that controllers’ roles were changing more than any other professional group because of big data. Most interviewees thought leveraging data from new sources is a team effort that requires contribution from all groups involved in decision making. Analysts are increasingly valued, but when asked about which professions are gaining influence in strategic decision making, no single group was identified. Neither was there visible competition between professional groups. IT staff, analysts and controllers still have their own different roles to play. Increased influence on decisions is considered to be dependent on individual skills and position in the organization.

”In simple terms, IT does the coding, analysts analyze, and controllers see if we have the money for it. So, at the moment, the roles do have their differences.” (Data analyst 1)

Volume of available data in the organization has grown exponentially in the last ten years. The information overload phenomenon is not just an issue of data analysts anymore. In the past, controllers often had a few streams of data, for instance sales and cost records, that were easier to comprehend and manage. Now, controllers too have access to databases with massive amounts of information from multiple sources. Management accounting tasks, such as forecasting and working capital management can benefit from these information sources. To bring value from big data to strategic decision making, controllers must assess which sets of data are irrelevant and which should be further analyzed.

“Times when there was not enough information available have been long gone for years.” (Data analyst 1)

Major shifts in controller's role towards strategic decision making would require outsourcing or automating most of the reporting tasks controllers must take care of at the moment. Big data technology and advancement in analytics tools could possibly assist in management reporting automation. In this case, however, some of the interviewees believed that the number of controllers would decrease instead of their roles changing.

> *"Systems could give warnings themselves and follow if a mistake has happened, so we wouldn't have to manually look for mistakes or problems. The need for so many controllers would probably also decrease. Reporting could be generated by the system and needed information would be easily accessible in the database." (Controller 3)*

Controllers consider data analytics and IT skills in general to be an important factor in keeping their job relevant in the future. They believe that most of basic accounting tasks will be automated and focus needs be shifted to more value-adding work, which could require more advanced data analytics skills. Furthermore, controllers should be open to changes and constantly develop themselves according to changes in the business environment. This could mean being familiar with the competitive landscape and learning to use new technologies quickly.

> *"There should be more data analysis and simulation in school. If you have no IT skills it is difficult to succeed in this world. Technology will increasingly enable getting value from datamining. Time goes by quickly, and you have to be able to develop yourself." (Controller 3)*

> *"The more responsibility you have in the organization, the better you should know the numbers. I don't think accounting will disappear from conducting business, vice versa, but some of the assisting jobs will surely change." (Data analyst 3)*

Both controllers and data analysts thought the organization could benefit in the future if the controller's role would be combined with the role of an analyst. Analysts are already doing tasks that are considered to belong to finance in many companies, such as investment risk and profitability calculations. They are also combining financial and non-financial figures by analyzing customer behavior surveys, for instance. With knowledge of both and thus a more holistic understanding of the business, the input to strategic decisions could be greater. For now, controllers were still thought to have accounting knowledge that data analysts would require if they were to acquire the controller's role.

> *"There would definitely be benefits if these professions merged and they probably will in some form." (Controller 3)*

"I think analysts could largely do the controller's job except for the balance sheet figures that are still unknown to most non-accountants. That is the advantage of controllers, because especially in an important organizational position, you need know the balance sheet as it essentially tells you how the business is doing." (Data analyst 3)

One of the identified challenges in leveraging large volumes of data was the people working with it. Whether a controller or not, actively going for new opportunities and changing old habits were considered a significant barrier for development. For management accounting professionals, leveraging new data sources and technologies requires a very proactive approach as it is usually not expected of them.

"I think the biggest challenge is people. Old habits, doing something inconvenient and the idea of 'this is how we have always done it' slow development down." (Data analyst 3)

"It is also a question of communication skills and dialogue. You should be able to make your expertise visible in the unit and show how you can add value to their processes." (Controller 4)

Education, training in the workplace and being proactive were identified as enablers of role development. Some controllers have experience in analytics from previous roles or education. However, no special mathematical or statistical abilities are required of controllers. Instead of training, some of the interviewees thought recruiting data analytics experts would be the first choice for the corporation.

"It is probably a question of recruitment." (Controller 2)

"There are probably many ways: education, training, but also self-development. Trying different roles, not just traditional accounting, helps in analyzing the business." (Data analyst 3)

Database complexities are another challenge for controllers in increasing their influence in strategic decision making by leveraging big data. Progress has been made in moving the data into a single system and improving its user-friendliness. However, even if controllers have access to these databases, most of them cannot directly be used without having wide experience on its different attributes. The organization is also structured so that analysts support the decision making and often serve as middlemen between external data and various organizational functions.

"The data is in many cases not very structured. There is a reason why we have separate analyst teams" (Data analyst 2)

Most controllers wish they would have more time to discuss about the opportunities brought by big data and advanced analytics. Some controllers have been able to proactively reduce manual reporting tasks by automating or delegating activities, but monthly reporting still takes considerable portion of working time. Despite minor improvements in accounting reporting systems, no significant decrease is expected in controllers' routine reporting tasks. Controllers see this as one of the main obstacles between them and big data analytics.

> *"It [big data analytics] is really fascinating and we have discussed with our colleagues how we could get started with it." (Controller 1)*

5. DISCUSSION

The purpose of this thesis is to investigate whether big data has had an impact on controller's role in organizations and whether it is contributing to the trend of controllers being more involved in strategic decision making. In this section, the empirical findings of the previous chapter are reflected against prior research presented in the literature review. First, the role of controllers in case study findings is analyzed, followed by a discussion on big data's impact on the role of controllers in strategic decision making.

5.1. CONTROLLER'S ROLE IN THE ORGANIZATION

Consistent with Granlund and Malmi (2002), controller's most important task in the case organization is to support managerial decisions from the financial perspective. Controllers do not work in the role of a beancounter described by Granlund and Lukka (1997). Understanding the business and the competitive environment is considered important for succeeding in the role. Routine reporting and searching for errors in financial figures are part of the job but not the main task for most controllers. Thus, the results are consistent with the findings of Granlund and Lukka (1998b) as well as those of Vaivio and Kokko (2006), who state that the role of controllers has expanded but not completely changed.

According to Rouwelaar and Bots (2008), organizational structure, industry and management preferences influence the role of controllers. This was also observable in the case organization. Controllers' influence on decision making is more significant in units where they are management team members. In addition, business understanding of the controller as well as the business in which the controller is working in were identified as main factors determining the role of controllers.

The effect of advanced information systems on controller's work is partly contrary to theory. Järvenpää (2001) states that modern accounting systems have freed time for contributing to developing the business. According to Herbert and Seal (2012), outsourcing core accounting tasks to a shared service center forces management accountants to justify their roles as business partners. The latter statement is consistent with case findings. However, as accounting systems develop, more reporting is required in addition to the reports generated by information systems. Furthermore, controllers face the information overload

phenomenon, where considerable time is spent on determining which data is relevant for decision making. This reduces time gained by automation from independent analysis and supporting management in business development.

Consistent with studies of Mintzberg (1976), Dent (1990) and Vaivio (2008), the case findings indicate that strategic decisions are complex processes affected by personalities and power that may be interrupted and don't have clear starting and ending points. The decision-making process is largely influenced by individuals initiating the action. Financial analyses are sometimes disregarded by decision-makers as Carr et al. (2010) found. Consistent with Colton's (2001) study, controller's involvement in strategic decisions is not consistent and repetitive but appears randomly when the controller's business unit is planning its strategy or a significant investment.

Most controllers in the case organization participate in strategic decision making of their business units as was found in the studies of Malmi et al. (2001) in Finland. There is an increasing demand of future-oriented strategic information and understanding of the external business environment. However, there are also controllers whose work is largely based on cost control and reporting of historical data. In strategic decisions, some controllers' role is limited to providing the needed information to decision makers, which is still consistent with Bhimani's and Keshtvarz's (1999) study of management accountants in the UK. As noted by Burns and Baldvinsdottir (2005), relationship with the unit manager was found to be a significant factor in determining controller's impact in strategic decisions.

5.2. IMPACT OF BIG DATA ON CONTROLLER'S ROLE

The phenomenon of big data is acknowledged and considered significant in the case organization. In accordance with Chen et al. (2012), location-aware and person-centered operations and transactions are offering new opportunities for the case company in marketing, logistics, and operations management. The three Vs that were initially used to define big data apply to the information collected by the case organization. The database sizes are massive, there are new data types available and the flow of information available for analysis is increasing. For instance, bonus card data from customer transactions, large customer satisfaction datasets and an increasing amount of information from the distribution chain can be defined as big data.

However, a change has not happened overnight; large amounts of data have been available in the organization for decades. In line with Bhimani and Willcocks (2014), new data on customer behavior is used to develop new products and selling strategies, but there has not been any sudden breakthroughs revolutionizing the business, as suggested in the Accenture study (2014) for instance. The focus in the case organization has been to organize and leverage the data already available instead of searching for new data sources.

The most significant challenge concerning big data in the case organization is to find value from the large volumes of data collected. Consistent with arguments of Bhimani and Willcocks (2014) as well as Gandomi and Haidar (2015), the case findings indicate that raw data is useless by itself, which is why plenty of resources are dedicated towards converging databases and improving analytics tools. Knowledge and understanding of the data and its collection process are needed to convert it into useful information for business decisions. Other challenges in leveraging big data include lack of data analytics experts and data privacy restrictions, which are similar to findings in earlier research (Pickard & Cokins, 2015; Warren et al., 2015).

There is no evidence of the threat presented by Quattrone (2016) that too much emphasis is put on data and human judgement is left to a minimum. Although the value of data-driven decision making is emphasized in the case organization, organizational politics still play a role in strategic decisions. Powerful individuals with authority can push their agenda through even if there is little or no quantifiable data to support their idea. Data can also be easily manipulated to show the consequences of wanted actions in a favorable light. This indicates that big data and data analytics have not changed the fact that political context and competing factions determine how decisions unfold, as argued by Cohen et al. (1972) and Dent (1990).

Contrary to some hypotheses (Bhimani, 2013; Bhimani & Willcocks, 2014; Warren et al., 2015), management accounting has not directly been impacted by new data sources in the case organization. In accordance with Appelbaum et al. (2017), management accountants are not yet utilizing predictive analytics tools in their analysis. Budgeting and management reporting done by controllers are still largely based on traditional financial data. There is an increased emphasis on using current information in decision making but most future-oriented

analysis is done by data analysts. Thus, contrary to Nielsen et al. (2014), management accountants are still primarily focusing on historical data and rarely expected to provide far-reaching predictive analysis. As noted by Arnaboldi et al. (2017), the complexity of data analytics and constant pressure linked to financial reporting hinders controllers from taking a larger role in leveraging analytics.

Consistent with Warren et al. (2015) and Bhimani and Willcocks (2014), information combined from different sales locations is used in designing new performance metrics, but decisions on those are made by individuals closer to operations, such as outlet managers. Unit strategies and targets are also increasingly data-driven. Strategy formation is based on realistic targets determined by a thorough data analysis of various profit centers. Controllers may be involved in the strategy formation process but, contrary to Bhimani and Willcocks (2014), a majority of the analysis is done by data specialists. Consequently, the impact of big data on controllers in traditional accounting roles has been limited.

However, some controllers are influenced by an increased emphasis on data-driven capital budgeting. As there is more comparable data available, realistic targets can be determined for new outlets and compared with investment proposals. This has an impact on controllers that are evaluating new investments with other professionals. As noted by Warren et al. (2015), outlet managers increasingly demand real-time feedback about consequences of their decisions and actions. A larger set of data can be utilized to spar managers and provide justification for or against investment decisions. There are also controllers involved in designing new services enabled by big data for customers. They contribute by providing the financial perspective to these development projects helping the organization determine the long-term profitability of new potential services.

In addition to capital budgeting, controllers may utilize new data sources in supply chain management. As hypothesized by Bhimani & Willcocks (2014), some controllers in the case organization are working in a major role in improving the data quality, accessibility and reporting of the logistics process. Current condition of inventory and sold products can be more closely monitored. This creates new opportunities for working capital management, which is a significant factor in high-volume retail business. Understanding working capital and balance sheet management may help controllers take the lead in these projects.

Earlier management accounting research (e.g. Bhimani & Willcocks, 2014; Warren et al., 2015; Al-Htaybat & Alberti-Alhtaybat, 2017) has suggested that management accountants have an opportunity to be in the forefront of leveraging big data and increase their influence in strategic decision making. The case findings show that there are controllers who have been impacted by availability of new information sources, analytics tools and the growing amount of data. They have opportunities to utilize new technologies and use newly available data in decision making. However, the scale of impact on controllers varies greatly. This thesis finds no evidence that controllers have been influenced more than other professional groups nor that they have increased their influence in strategic decisions by leveraging big data.

The impact of big data on controller's role in strategic decisions is very much dependent on the organizational position of the controller. If the controller is working in a business unit where big data is utilized, he or she is more likely to leverage it in financial analysis. Being part of unit's management team also enables the use of a wider range of data sources through data analysts. When the controller is not involved in strategic decisions as a part of a management team, there are few opportunities to leverage new sources of data. Consistent with Pickard & Cokins (2015), lack of analytics skills is also considered a factor limiting management accountants' big data utilization. There were no signs of controllers acting as informed skeptics that have the knowledge to challenge the analysis of others working with analytics, as suggested by McKinney et al. (2017).

However, organizational position or lack of technical knowledge were not the main factors hindering controller's use of big data. In the case organization, lack of business understanding was identified as the most significant factor that prevents controllers from participating in strategic decision making and utilizing data analytics. Many controllers in the case organization only have experience of traditional accounting tasks and a narrow view of the business. This is contrary to the arguments of Bhimani and Willcocks (2014) and Schneider et al. (2015) that big data could increase their influence because of a thorough understanding of the business as a whole. In fact, data analysts in the case organization were thought to have a more holistic view of the business compared to average controllers.

Controllers are often distanced from operations, which hurt their abilities to participate in strategic decision making, as argued by Payne (2014).

Controller's individual characteristics also play a significant role. Even if the manager encourages the controller's proposals on development of management accounting in the case organization, the mindset of the controller is considered to be the key. Willingness to adopt new technologies and proactively searching for new ways to utilize data are seen as enablers of role development, consistent with Goretzki et al. (2013). However, big data was not seen as such a large-scale phenomenon that would trigger a controller's role for re-interpretation, as suggested by Alvesson and Willmott (2002). Some controllers clearly saw data analytics as data analysts' work and thought that significant decisions on the use of big data are made higher in the organizational hierarchy. These results are in accordance with the argument of Arnaboldi et al. (2017) that controllers often do not see big data as a resource.

Importance of communication was emphasized by both data analysts and controllers. Consistent with Payne (2014), McKinney et al. (2017) and Quattrone (2016), leveraging big data is a collective effort between professionals of different backgrounds. Diversity in management teams was thought to have a positive impact on strategic decisions' quality, as argued by Amason (1996). Experts in data analytics are required to organize and analyze most unstructured data, which increases the dependency of other professionals on data analysts. This has implications for strategic decision making, as it leverages analysis produced by data specialists and increases their influence. However, as found by Al-Htaybat & Alberti-Alhtaybat (2017), accounting professionals may be able to see the impacts of this data on the organization's financial position, which others without accounting experience may not recognize.

Some of the data analysts in the case organization have previously worked as controllers and vice versa. This indicates that the roles do not differ significantly from each other. As suggested by Bhimani and Willcocks (2014), it was believed by some interviewees that the two professions will be combined in the future. However, instead of management accountants becoming data experts, as argued by Bhimani and Willcocks (2014), it was thought to be more likely that data experts acquire the tasks of controllers. Data analysts are already involved in management reporting and forecasting financial performance. Consistent

with the findings of Kurunmäki (2004), traditional accounting tasks have been effortlessly transferred without any visible competition. Usually, analysts analyze the big picture of where the business is and where it is going for management decision making whereas controllers focus more on cost control and budgeting cycles of their units.

For now, however, accounting knowledge gained by accounting education and work experience was found to differentiate controllers from other professionals. In many cases, controllers were management team members whereas data analysts were not. As stated by Bhimani and Willcocks (2014) as well as Al-Htaybat and Alberti-Alhtaybat (2017), practical experience and knowledge of accounting principles and balance sheet analysis are expected to keep management accountants relevant in the organization. Consistent with prior theory (e.g. Bhimani & Willcocks 2014; Warren et al., 2015), controllers emphasized the importance of being able develop their own skills and react to changes in the business environment.

New sources of data, advanced analytics and automation are expected eliminate some assisting accounting tasks of controllers in the case organization and increase the importance of understanding the business and its implications to financial performance. Consistent with arguments of Bhimani and Willcocks (2014), this indicates that big data is one of the factors slowly forcing controllers towards further business orientation and more value-adding work. As big data and data analytics shift to a more strategic role in organizations, controllers should acquire a solid understanding of the business and opportunities brought by big data to remain relevant and have a say strategic decision making.

6. CONCLUSIONS

6.1. RESEARCH SUMMARY

The purpose of this thesis was to investigate the impact of big data on controller's role in strategic decision making. The study aimed to shed light on the future of the controller's profession by examining whether the big data phenomenon is furthering the trend of controllers expanding their role beyond financials to wider business orientation and strategic decision making. This thesis is a qualitative case study conducted in a Finnish retail and service corporation. The empirical evidence is based on nine semi-structured interviews of controllers and data analysts in SOK, a corporation that offers various support functions and strategic guidance to the S Group, which is a network of largely Finnish companies operating in the retail and service sectors.

The research results indicate that big data is one of the many factors forcing controllers towards a more strategic role in organizations, consistent with Bhimani and Willcocks (2014). There are future-oriented controllers contributing to strategic decision making and serving as true business partners to managers. At the same time, some controllers' work is still largely based on routine reporting and cost control responsibilities, as found by Granlund and Lukka (1998b) as well as Vaivio and Kokko (2006). New sources of data require more advanced analytics and automation, which are expected to eliminate some of today's assisting accounting tasks. Consequently, the need for controllers in traditional management reporting and cost control roles will most likely decrease.

As hypothesized in earlier research (e.g. Chen et al., 2012; McAfee & Brynjolfsson, 2012), location-aware and person-centered operations and transactions are offering new opportunities in the fields of marketing, logistics, and operations management. There are controllers who are involved in utilizing these new data sources in increasingly data-driven decision making. However, contrary to some hypotheses (Bhimani, 2013; Bhimani & Willcocks, 2014; Warren et al., 2015), this study indicates that management accounting has not directly been impacted by big data. Budgeting, forecasting and management reporting done by controllers is still largely based on traditional financial information. Management accountants are not expected to provide far-reaching predictive analysis, contrary to Nielsen

et al. (2014) and Warren et al. (2015). Thus, the impact of big data on controllers' work has been limited.

Despite the opportunities offered by new data sources, controllers have not been influenced more than any other professional group nor have they increased their influence in strategic decisions by leveraging big data. The research results are contrary to the arguments of Bhimani and Willcocks (2014) and Schneider et al. (2015) that big data would increase management accountants' influence as they have a thorough understanding of the business as a whole. Lack of business understanding was identified as the most significant factor that prevents controllers from participating in strategic decision making and utilizing advanced data analytics in these decisions. Furthermore, manager preferences and the controller's own attitude towards new analytics tools seem to hinder role development.

As noted in earlier accounting and strategy literature (e.g. Dent, 1990; Cohen et al., 1972), strategic decisions are influenced by individuals and politics between competing factions despite an increasing emphasis on data-driven decision making. Consistent with McKinney et al. (2017) and Quattrone (2016), leveraging big data in strategic decisions is a collective effort between professionals of different backgrounds. However, experts in data analytics are required to organize and analyze most unstructured data, which increases the dependency of other professionals on data analysts. The strategy formation process is also increasingly data-driven. Controllers may be involved in the process but, contrary to Bhimani and Willcocks (2014), a majority of the analysis is done by data specialists.

Consistent with Kurunmäki's (2004) study, some traditional accounting tasks can be effortlessly transferred from controllers to data analysts. Because of their similarities, the two professions may be combined in the future. However, instead of management accountants becoming data specialists, as argued by Bhimani and Willcocks (2014), the research results indicate that it is more likely that data experts acquire the tasks of controllers. Data analysts are already collecting and analyzing financial information. Currently, however, controllers' knowledge of accounting principles differentiates them from other professionals.

This study indicates that controllers are not in the forefront of utilizing big data in strategic decision making. To remain relevant and continue the expansion towards a more strategic role, controllers must find ways to leverage both new and existing sources of data in long-term business decisions. Data specialists are increasing their influence as data analytics play a larger role in organizations. This could be a wake-up call for controllers to get involved in the process of extracting valuable insight from raw data and ensure its reliability. With accounting knowledge gained from education and work experience, controllers may be able to bring a needed financial perspective to this process. However, this will require a holistic understanding of the business and close cooperation with other professionals.

6.2. LIMITATIONS OF THE STUDY

In qualitative research, the researcher always trades the scope of the study to achieve a deeper understanding of the studied phenomenon. The empirical findings of this thesis are based on a case study in one organization, which raises questions about the generalizability of the results. The case corporation is large and one of the leading companies in analytics utilization in the retail and hospitality industries in Finland. It is likely that in a smaller company or a different industry with less data available, the big data phenomenon is less relevant or at least appears in a different way. Furthermore, defining a common role for today's controllers is extremely difficult as they work in different roles even within the same company. The role presented in this thesis may not be applicable to controllers in other industries or organizational structures.

Another typical limitation in qualitative research is researcher bias. The large set of observations in case studies always leaves room for interpretation that is heavily dependent on the individual researcher. Selecting the key observations and drawing conclusions from them requires skills and can easily be influenced by personal biases. Inevitably, cultural background, education and other prior experiences affect the researcher's view of the studied phenomenon. In this case, conducting research on controller's role and big data as an accounting student may produce different results compared to someone with an information technology background, for instance. Furthermore, preconceptions about a widely known organization in Finland may have influenced the way the case company was approached in the first place.

The fact that the big data phenomenon is in its early stages also has implications for the study's generalizability. As data analysis technology and tools are developing at a fast pace, the data insight extraction process and its influence in organizations may be different in a few years' time. The trendiness of the topic may also result in interviewees presenting themselves in a favorable light in respect to data analytics and analysis skills. The same issue may be present when discussing controllers' own roles in the organization. The interviewed controllers may not provide candid answers about their role and influence if they suspect their views are shared with their colleagues.

With a new topic from the perspective of management accounting, this study represents a preliminary investigation into the impact of big data on controller's role in a single case context. More interviews and time spent on the research site could have increased the amount of valid empirical evidence available for analysis. In addition, using more data sources and achieving further data triangulation could have improved the reliability of the research results. Participating in management team meetings and interviewing other professionals besides controllers and data analysts could have resulted in a more diverse view of the studied phenomenon. The conclusions of this study are merely early indications about the future development of management accounting and the role of controllers.

6.3. SUGGESTIONS FOR FURTHER RESEARCH

This thesis raises numerous avenues for further research as it addresses a very novel research area. Prior literature presents predictions on the impact of big data and data analytics on management accounting, but there is still a lack of empirical evidence on the phenomenon. Instead of surveying hundreds of companies, a deeper understanding could be achieved by conducting more qualitative research in different organizational contexts and testing hypotheses presented in earlier literature. Case studies in leading companies utilizing big data would provide valuable contribution to literature and show direction for the development of the role of management accounting in an increasingly data-driven business environment. In addition to retail, there are several other industries where big data already plays a significant role. For instance, health care companies and banks leverage massive amounts of data and could provide interesting empirical evidence on the opportunities and implications of big data.

In addition to controllers, interviewing top management would offer new perspectives on the future of management accountants. CEOs and CFOs are typically future-oriented and have a thorough understanding of the business landscape. Their views on the role of management accounting in modern organizations may differ from management accountants themselves and reveal more about the future of the profession. As data analytics becomes increasingly important in various industries, it would be worth investigating how they manage and utilize different functions of the organization to find value from raw data.

Another topic that deserves more attention from academics is strategic decision making in an increasingly data-driven business environment. This thesis briefly addressed how powerful individuals still influence how decisions unfold regardless of what the numerical evidence indicates. From the perspectives of management accounting and strategic management, it would be vital to investigate if strategic decision making has actually become more data-driven or are organizational politics still playing a major role. A suitable research site for this subject would be an organization that is deliberately aiming for increasingly data-driven decisions. An illustrative case study of decision-making practices in a company embracing data analytics could reveal new practices and help us broaden our understanding of decision making in modern organizations.

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APPENDICES

APPENDIX 1: LIST OF INTERVIEWS

Controller 1	7.9.2017	65 min
Controller 2	7.9.2017	60 min
Controller 3	10.11.2017	60 min
Controller 4	7.12.2017	55 min
Controller 5	7.12.2017	45 min
Controller 6	18.12.2017	65 min
Data analyst 1	14.9.2017	60 min
Data analyst 2	13.11.2017	45 min
Data analyst 3	1.12.2017	60 min

APPENDIX 2: SEMI-STRUCTURED INTERVIEW TEMPLATES

Controller interview template

1. Role and tasks
    a. What is your most important task and purpose in the organization?
    b. How is your time allocated between different tasks?
2. Strategic decision making
    a. How would you describe the cooperation between you and your manager?
    b. How would you describe the strategic decision-making process in the unit you work in?
    c. What is the controller's role in strategic decisions?
    d. Do you consider yourself to be a sparring partner or a material provider?
    e. Which factors influence controller's role in strategic decisions?
3. Data analytics and big data
    a. How is data analytics utilized in your business unit?
    b. Is data from new sources leveraged in decision making?
    c. Have new analytics tools or the growing amount of data available influenced your work or role in the organization?
    d. What do you think is required from controllers to stay relevant in modern organizations?

Data analyst interview template

1. Role and tasks
    a. What is your most important task and purpose in the organization?
2. Strategic decision making
    a. How would you describe the cooperation between you and your manager?
    b. How would you describe the strategic decision-making process in the unit you work in?
    c. What is the data analyst's role in strategic decisions?
    d. Do you consider yourself to be a sparring partner or a material provider?
3. Data analytics and big data
    a. How is data analytics utilized in your business unit?
    b. Is data from new sources leveraged in decision making?
    c. What is the most significant business potential of big data for the organization?
    d. Have new analytics tools or the growing amount of data available influenced your work or role in the organization?
    e. How would you describe controller's role in the organization?
    f. What do you think is required from controllers to stay relevant in modern organizations?